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Forest Statistics for Minnesota's **Northern Pine Unit**

Pat Murray

'90

This report includes the most commonly used Forest Inventory and Analysis statistics. However, additional forest resource data can be provided to interested users. Persons requesting additional information that can be provided from the raw inventory data are expected to pay the retrieval costs. These costs range from less than $100 for a relatively simple request to $2,000 for a complex retrieval involving the services of a Forest Inventory and Analysis computer programmer. Requests will be filled so as to minimize the impact on the Forest Inventory and Analysis Work Unit.

Requests for information may be directed to:

Project Leader
Forest Inventory and Analysis
North Central Forest Experiment Station
1992 Folwell Avenue
St. Paul, Minnesota 55108
Phone: (612) 649-5139

or

State Forester
Minnesota Department of Natural Resources
Forestry Division
P.O. Box 44
500 Lafayette Road
St. Paul, Minnesota 55146
Phone: (612) 296-6491

Area served: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, Wisconsin

North Central Forest Experiment Station
Forest Service—U.S. Department of Agriculture
1992 Folwell Avenue
St. Paul, Minnesota 55108
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FOREWORD

Forest Inventory and Analysis (FIA) is a continuing endeavor as mandated by the Renewable Forest and Rangeland Resources Planning Act of 1974. Prior inventories were mandated by the McSweeney-McNary Forest Research Act of 1928. The objective of FIA is to periodically inventory the Nation's forest land to determine its extent, condition, volume of timber, growth, and removals. Up-to-date resource information is essential to frame forest policies and programs. USDA Forest Service regional experiment stations are responsible for conducting these inventories and publishing summary reports for individual States. The North Central Forest Experiment Station is responsible for forest inventory and analysis in Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin.

Fieldwork for the Minnesota Northern Pine Unit forest inventory was begun in July 1988 and completed in October 1990. Reports of four previous inventories of Minnesota's timber resource are dated 1936, 1953, 1962, and 1977.

More accurate survey information was obtained during this survey than otherwise would have been feasible because of intensified field sampling. Such sampling was made possible through the cooperation and assistance of the Minnesota Department of Natural Resources (MDNR). Data for the Northern Pine Unit were collected by contract crews hired and supervised by the MDNR. To aid in determining current timber removals, the MDNR also surveyed primary wood-using plants in the State.

Aerial photos used in the Northern Pine Unit forest inventory were purchased by the State from U.S. Geological Survey. This photography was from the National High Altitude Photography program (NHAP). In addition, MDNR provided 35mm true color prints at a scale of 1:15,840 of all of the 1977 plot locations for disturbance detection.

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Forest Statistics for Minnesota's Northern Pine Unit

Pat Murray

HIGHLIGHTS

NOTE: *Data from new forest inventories are often compared with data from earlier inventories to determine trends in forest resources. However, for the comparisons to be valid, the procedures used in the two inventories must be similar. As a result of our ongoing efforts to improve the efficiency and reliability of the inventory, several changes in procedures and definitions have occurred since 1977. Because some of these changes will make it inappropriate to directly compare the 1990 data with those published for 1977, data from the 1977 inventory have been reprocessed using the 1990 procedures. Please refer to the section labeled "Comparing Minnesota's Fifth Inventory With the Fourth Inventory" for more details.* ***The data in this report are subject to change when inventory data for the entire State have been compiled. It is expected, however, that any such changes will be minor.***

General

The Northern Pine Survey Unit consists of 12 counties in north-central Minnesota (see cover). Two unique geographic features of this Unit include the headwaters of the Mississippi River in Itasca County and the northernmost point of the contiguous United States known as the "Northwest Angle" in Lake of the Woods County. The original vegetation of the Unit was almost exclusively forest except for small areas of native prairie in Hubbard, Becker, and Wadena Counties. This forest included black spruce and tamarack on the peat lands, red pine on the gravelly moraines and till plains, and jack pine on the outwash and along the Mississippi and Crow Wing Rivers. Heavier soils supported balsam fir and white spruce in the northern reaches of the Unit with maple, basswood, and oak in the south. Magnificent white and red pine stands exceeding 30 thousand board feet per acre were not uncommon. Repeated logging, fires, and settlement drastically altered the character of the forest. Today's maturing second- and third-growth forest supports all of the original tree species but in clearly different proportions, with many upland sites supporting the pioneer species of aspen and birch. The lowlands continue to be dominated by black spruce, balsam fir, tamarack, and black ash.

Forest Area

- The Northern Pine Unit contains 11.1 million acres of land. The area of all forest land in the Unit has declined 2.7 percent since 1977 to 6.3 million acres. The current forest area includes 34 thousand acres of reserved forest land where harvesting is prohibited by statute or administrative designation.

- Ninety-four percent—6 million acres—of the forest land in the Unit is classified as timberland. This is forest land that is capable of or is producing 20 cubic feet or more of industrial wood crops and is not withdrawn from timber harvesting. Between 1977 and 1990, area of timberland in the Unit increased 217,100 acres.

Pat Murray, Computer Specialist, began her career with the Forest Service at the Bena Ranger Station of the Chippewa National Forest in 1966. She joined North Central's Forest Inventory and Analysis Unit as a Statistical Assistant in 1976. Pat retired in 1990 after 24 years with the Forest Service.

- Timberland in the Northern Pine Unit has remained relatively stable for the past 30 years (fig. 1). Although the proportion of the aspen type declined slightly over the past three decades, it still comprises nearly 40 percent of the timberland with 2.4 million acres. The areas of black spruce, northern white-cedar, and tamarack timberland have all increased by more than 25 percent since 1977. This increase is attributed to areas classified as unproductive in 1977 and reclassified as marginally productive in 1990.

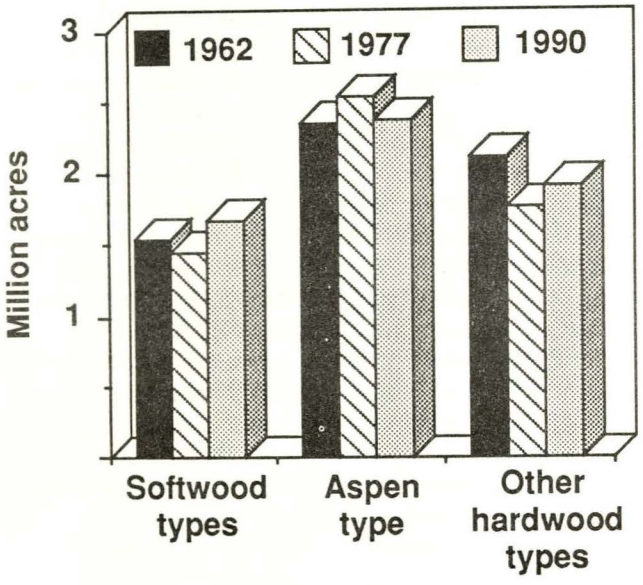

Figure 1.—*Area of timberland in the Northern Pine Unit by major forest type group, 1962, 1977, and 1990.*

- Fifty-four percent—3.2 million acres—of the Unit's timberland is in public ownership (fig. 2). The largest owner is the State of Minnesota, with nearly 1.4 million acres, followed by county and municipal governments with 1.2 million acres, and the Chippewa National Forest with 567 thousand acres. The Northern Pine Unit has 17 percent of all timberland owned by county and municipal governments in the Nation.

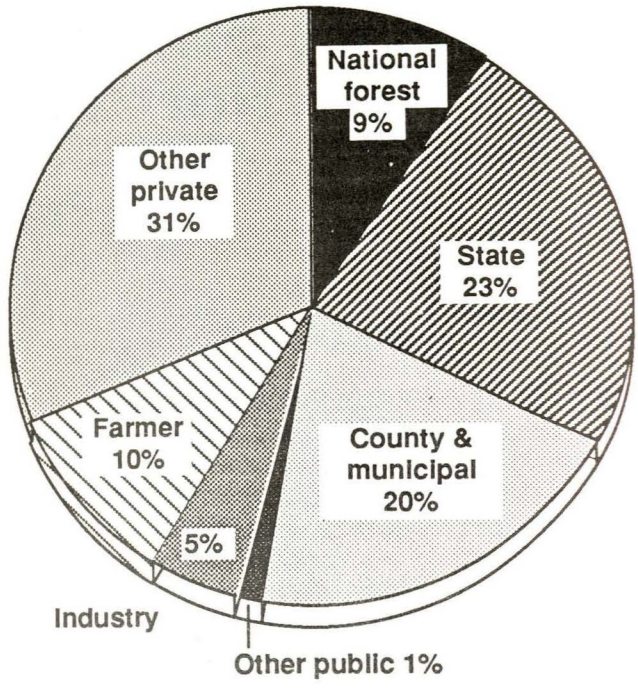

Figure 2.—*Distribution of timberland in the Northern Pine Unit by ownership class, 1990.*

- Of the 2.7 million acres of timberland that is privately owned, 1.3 million acres are held by miscellaneous individuals. Forest industries own 285 thousand acres. The area of farmer owned timberland stands at 597 thousand acres, down from 1.3 million in 1977.

- The area of sawtimber-size stands has increased by 716 thousand acres since 1977; and the Unit is close to a balanced distribution by stand-size class with 33 percent of timberland in sawtimber, 38 percent in poletimber, and 28 percent in seedling-sapling stands.

Volume

- The volume of timber in the Northern Pine Unit totals 6.6 billion cubic feet, averaging 1,102 cubic feet per acre, an increase of 31 percent since 1977.

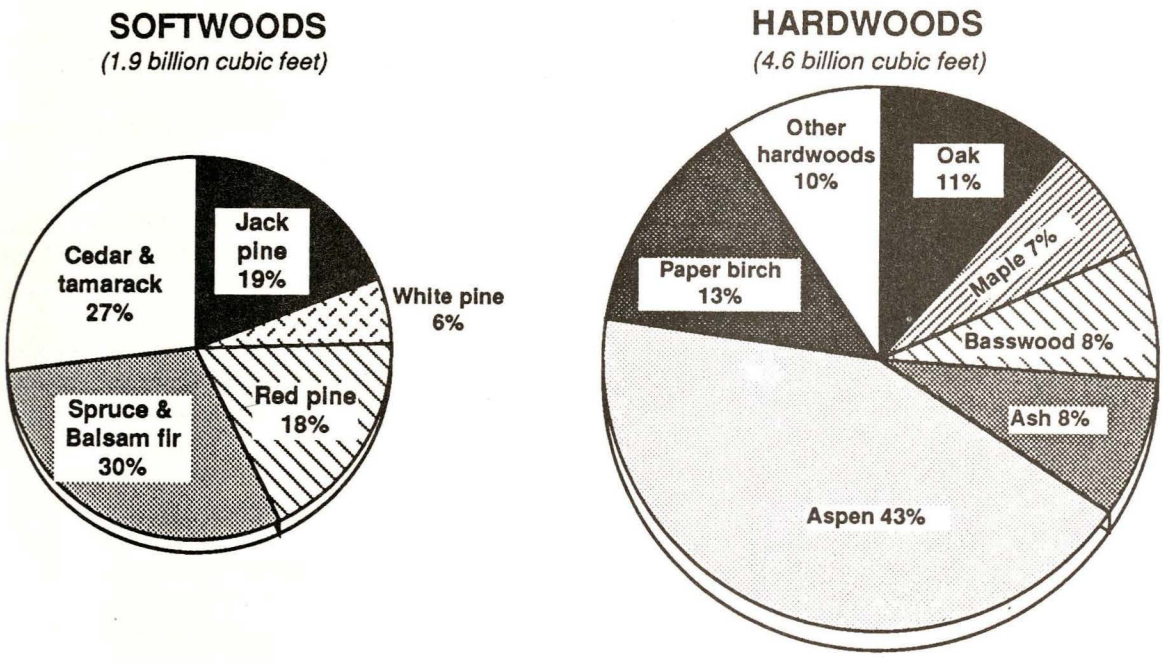

Figure 3.—*Volume of growing stock on timberland in the Northern Pine Unit by species group, 1990.*

- Aspen accounts for 43 percent of the 4.6 billion cubic feet of hardwood growing stock in the Unit (fig. 3). Jack, red, and white pine account for 43 percent of the 1.9 billion cubic feet of softwoods.

- Sawtimber volume in the Northern Pine Unit stands at 15 billion board feet, up 42 percent from 1977. Sawtimber volume averaged 2,512 board feet per acre in 1990.

- The largest holder of growing-stock volume is county and municipal governments with 1.4 billion cubic feet, averaging 1,180 cubic feet per acre, of which about 75 percent is hardwoods.

- State lands hold 1.2 billion cubic feet of growing stock, averaging 997 cubic feet per acre. Nearly one-third of the volume on State lands is lowland conifers such as black spruce, tamarack, and northern white-cedar. This is indicative of the fact that much of the State land is on poor wet sites.

- The Chippewa National Forest contains 743 million cubic feet of growing stock (fig. 4). Volume per acre on the National Forest is 1,310 cubic feet, highest for any ownership class in the Unit.

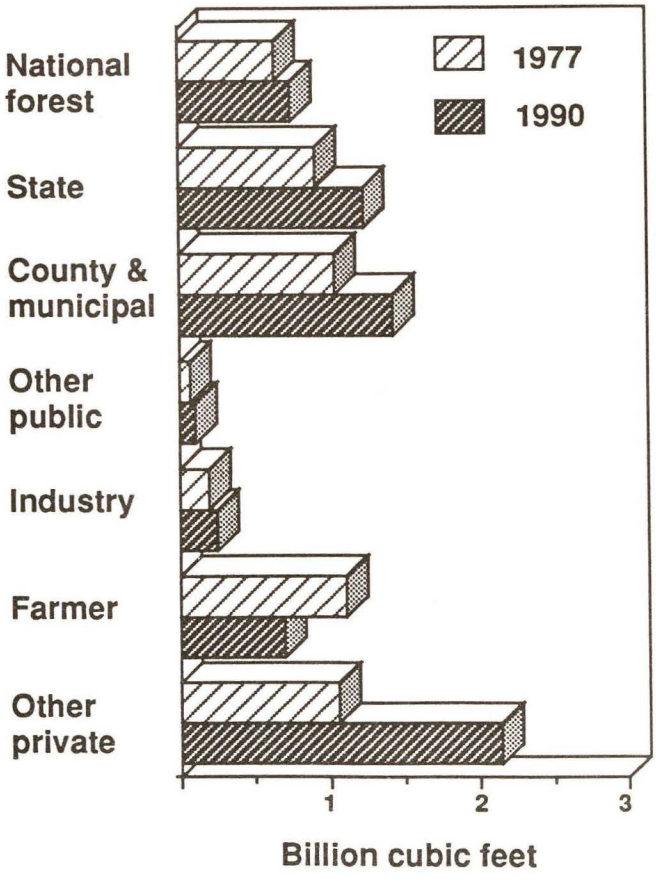

Figure 4.—*Net volume of growing stock on timberland in the Northern Pine Unit by ownership class, 1977 and 1990.*

Timber Growth, Mortality, and Removals

- Net annual growth of growing stock on timberland averaged 169.8 million cubic feet per year from 1977 through 1989 (fig. 5). This is an average of 28.4 cubic feet per acre per year.

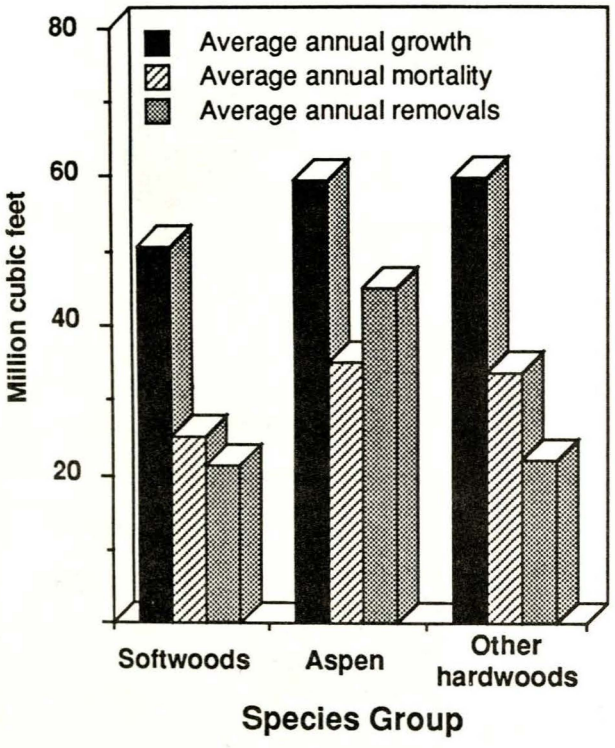

Figure 5.—*Average annual growing-stock growth, removals, and mortality on timberland in the Northern Pine Unit by species group, 1977-1989.*

- Softwood growth averaged 50.5 million cubic feet, or 2.3 percent of the softwood inventory. Hardwood growth averaged 119.3 million cubic feet, or 2.2 percent of the hardwood inventory.

- Mortality of growing stock averaged 92.3 million cubic feet per year from 1977 through 1989.

- Average annual removals of growing stock from timberland was 87.9 million cubic feet per year from 1977 through 1989. This is 52 percent of average net annual growth.

- Softwood removals for the period averaged 21.2 million cubic feet. Hardwood removals averaged 66.7 million cubic feet.

- Current annual growth of growing stock on timberland was 212.3 million cubic feet in 1989. This is an average of 35.5 cubic feet per acre per year. Current annual growth will usually exceed average annual growth when there is rapid maturation of second-growth forests or in response to increased management on existing stands. Both of these situations are currently occurring throughout the Lake States.

- Aspen growth averaged 59.4 million cubic feet from 1977 through 1989. Removals of aspen averaged 44.8 million cubic feet per year. However, in 1989, aspen growth in the Northern Pine Unit was 66.5 million cubic feet and removals was 76.4 million.

- Total removals of growing stock on timberland in 1988 stood at 117.5 million cubic feet—55 percent of current annual growth.

APPENDIX

ACCURACY OF THE SURVEY

Forest Inventory and Analysis information is based on a sampling procedure designed to provide reliable statistics at the State and Survey Unit levels. Consequently, the reported figures are estimates only. A measure of reliability of these figures is given by sampling errors. These sampling errors mean that the chances are two out of three that if a 100-percent inventory had been taken, using the same methods, the results would have been within the limits indicated.

For example, the estimated growing-stock volume in the Unit in 1990, 6,586.3 million cubic feet, has a sampling error of ±0.98 percent (±64.5 million cubic feet). The growing-stock volume from a 100-percent inventory would be expected to fall between 6,521.8 and 6,650.8 million cubic feet (6,586.3 ± 64.5, there being a one in three chance that this is not the case.

The following tabulation shows the sampling errors for the Northern Pine Forest Inventory:

Item	Unit totals	Sampling error
Growing-stock	(Million cubic feet)	(Percent)
Volume (1990)	6,586.3	0.98
Average annual growth (1977-1989)	169.8	1.55
Average annual removals (1977-1989)	87.9	5.51
Sawtimber	(Million board feet)	
Volume (1990)	15,008.8	1.39
Average annual growth (1977-1989)	603.1	1.74
Average annual removals (1977-1989)	212.4	5.41
Timberland	(Thousand acres)	
Area (1990)	5,975.5	.49

As survey data are broken down into sections smaller than Survey Unit totals, the sampling error increases. For example, the sampling error for timberland area in a particular county is higher than that for total timberland area in the Unit. This tabulation shows the sampling errors for Unit totals. To estimate sampling error for data smaller than Unit totals, use the following formula:

$$E = \frac{(SE)\ \sqrt{\text{(Unit total area or volume)}}}{\sqrt{\text{(Volume or area smaller than Unit total)}}}$$

where:

E = sampling error in percent
SE = Unit total error for area or volume

For example, to compute the error on the area of timberland in the elm-ash-soft maple in the Unit, proceed as follows:

The total area of elm-ash-soft maple type in the Unit from table 3 = 488,000 acres

The total area of all timberland in the Unit from table 3 = 5,975,500

The Unit total error for timberland area from the above tabulation = 0.49 percent

Using the above formula:

$$\text{Error} = \frac{(0.49)\ \sqrt{5{,}975{,}500}}{\sqrt{488{,}100}}$$

$$= \pm 1.71 \text{ percent}$$

SURVEY PROCEDURES

The 1990 Minnesota survey used a growth model-enhanced, two-phase sample design. Using this sampling scheme and associated estimators is similar to sampling with partial replacement (SPR), in that a set of randomly located plots is available for remeasurement and a random set of new plots is established and measured. A significant feature of the new Minnesota design is stratification for disturbance on the old sample and use of a growth model to improve regression estimates made on old undisturbed forest plots (fig. 6). Detailed descriptions of the sampling and estimation procedures are presented by Hansen (1990)[1].

[1] *Hansen, Mark H. 1990. A comprehensive sampling system for forest inventory based on an individual tree growth model. St. Paul, MN: University of Minnesota, College of Natural Resources. 256 p. Ph.D. Dissertation.*

The growth model used in the Minnesota survey design was the Lake States Stand and Tree Evaluation and Modeling System (STEMS)[2].

These were the major steps in the new survey design:

1. Aerial photography (Phase 1)

In this phase two sets of random points were located on current aerial photography. The first is a set of new photo plots and the second is a set of relocated old ground plot locations from the 1977 inventory. Photos were 1:58,000 scale color infrared National High Altitude Photo program (NHAP) prints purchased by the Minnesota

[2] *Belcher, David W.; Holdaway, Margaret R.; Brand, Gary J. 1982. A description of STEMS the Stand and Tree Evaluation and Modeling System. Gen. Tech. Rep NC-79. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 18 p.*

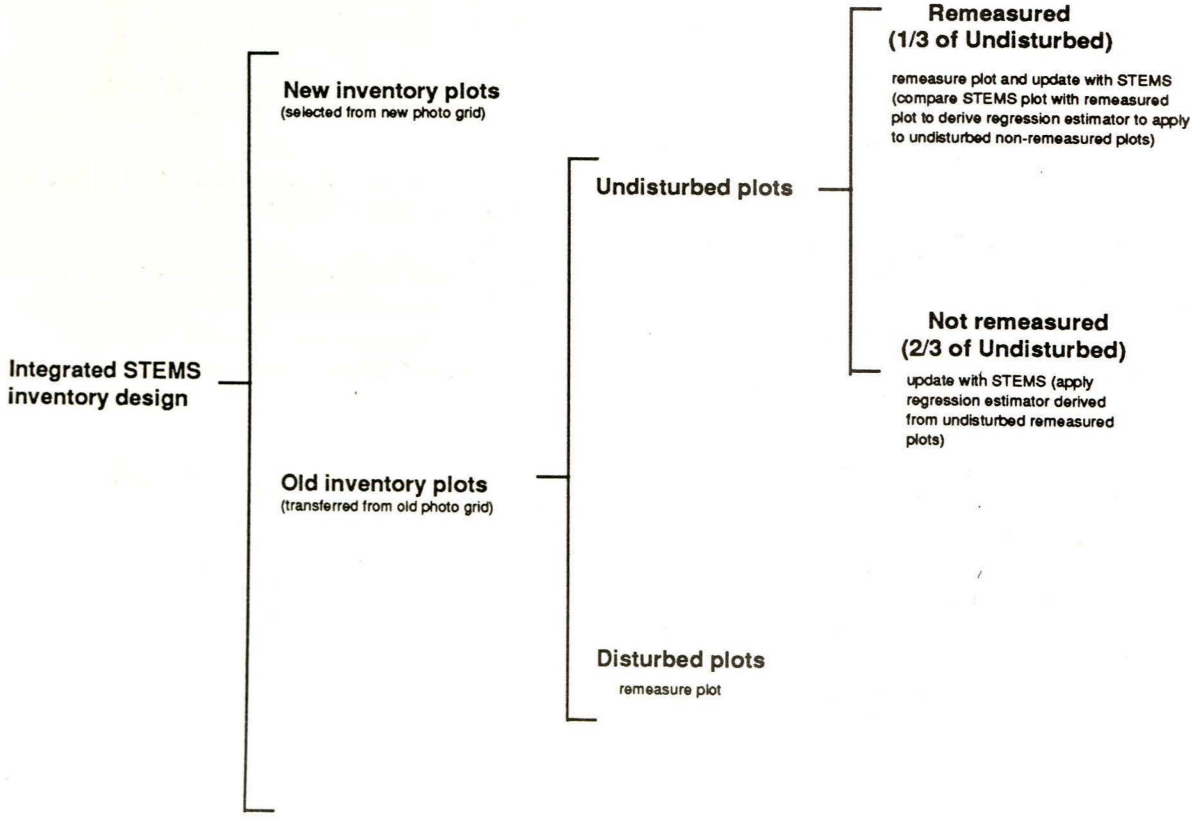
Integrated STEMS inventory design
New inventory plots
(selected from new photo grid)
Old inventory plots
(transferred from old photo grid)
Undisturbed plots
Disturbed plots
remeasure plot
Remeasured
(1/3 of Undisturbed)
remeasure plot and update with STEMS (compare STEMS plot with remeasured plot to derive regression estimator to apply to undisturbed non-remeasured plots)
Not remeasured
(2/3 of Undisturbed)
update with STEMS (apply regression estimator derived from undisturbed remeasured plots)

Figure 6.—Overview of the Minnesota sample design.

Department of Natural Resources (MDNR) from the U.S. Geological Survey. In addition, MDNR provided 35mm true color prints at a scale of 1:15,840 of all of the 1977 ground plot locations. These 35mm prints were used in addition to the NHAP prints to help detect disturbances in the 1977 ground plot locations. The year of photography for each county in the Unit is shown below.

	Date	
County	NHAP	35mm
Aitkin	1984-1985	1987
Becker	1983-1984	1988
Beltrami	1981-1983	1987
Cass	1981	1988
Clearwater	1982-1983	1987-1988
Crow Wing	1981	1988
Hubbard	1984-1985	1988
Itasca	1981	1987-1988
Lake of the Woods	1981-1982	1985
Mahnomen	1983-1984	1988
Roseau	1982-1983	1988
Wadena	1983	1989

The locations of the plots used in the 1977 inventory were transferred to these new photographs. The photographs were then assembled into township mosaics, and a systematic grid of 121 one-acre photo plots (each plot representing approximately 190.4 acres) was overlaid on each township mosaic. Each of these photo plots was examined by aerial photogrammetrists and classified stereoscopically based on land use. If trees were present, forest type and stand-size density class were recorded. All of the 1977 ground plot locations were also examined for disturbance (logging, fire, catastrophic mortality, etc.) with the aid of the 35mm photographs. After this examination, all the old "disturbed" sample locations, a one-third sample of the old "undisturbed" sample locations, and a sample of the new photo plots were sent to the field for survey crews to verify the photo classification and to take further measurements. All photo plot locations for the 1990 inventory were examined for the Northern Pine Unit and were classified as shown in the following tabulation:

Photo land class	Photo plots
Timberland	29,729
Reserved forest land	137
Other forest land	2,015
Questionable	645
Nonforest with trees	1,218
Nonforest without trees	24,097
Water	8,112
All classes	65,953

2. Plot measurements (Phase 2)

On plots classified as timberland, wooded pasture, or windbreak (at least 120 feet wide), a ground plot was established, remeasured, or modeled. Old plots sent to the field for remeasurement that could not be relocated were replaced with a new plot at the approximate location of the old one. Each ground plot consists of a 10-point cluster covering approximately 1 acre. At each point, trees 5.0 inches or more in d.b.h. were sampled on a 37.5 Basal Area Factor (BAF) variable-radius plot, and trees less than 5.0 inches d.b.h. were sampled on a 1/300-acre fixed-radius plot. The measurement procedure for the new and old sample locations was as follows:

a. New inventory plots

A random sample of the new photo plots was selected for field measurement. Ground plots were established, and measures of current classification such as land use, forest type, and ownership as well as size and condition of all trees on the plot were recorded. These locations were monumented for future remeasurement.

b. Old inventory plots

These plots were established, monumented, and measured as part of the 1977 field inventory. The procedures for these old plot locations were different from those for the new plots. Old plots were classed as "undisturbed" or "disturbed" in the aerial photo phase of the sampling process. All disturbed plots and a one-third sample of the undisturbed plots were remeasured to obtain estimates of current condition and changes since the last inventory. All trees measured on these plots in 1977 were remeasured or otherwise accounted for, and all new trees were identified and measured.

All sample plots that were forested at the time of the 1977 inventory and determined to be undisturbed until this inventory were projected to the current time using STEMS. This procedure gives projected estimates of current volume and growth for these undisturbed plots. The comparison of the projected and observed values on the one-third sample of the undisturbed forest plots that were remeasured provided local calibration data to adjust the projected values of the undisturbed plots that were not remeasured. The adjustment procedure is a modified version of the method described by Smith[3].

The old sample plots that were not forested in 1977 and were determined to be undisturbed until the current inventory (no evidence of conversion to another land use) were also subsampled (field checked) at the one-third rate. Any changes in land use to forest detected on these plots were used to adjust the two-thirds sample of these plots not field checked. The field check of these points in the Northern Pine Unit indicated that no adjustment was necessary.

The undisturbed plots that were not remeasured play a crucial role in the new survey design. These plots, after careful examination comparing past and current aerial photography, were determined to be undisturbed and had conditions that could be simulated by STEMS.

[3] *Smith, W. Brad. 1983. Adjusting the STEMS regional growth models to improve local predictions. Res. Note NC-297. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 5 p.*

The STEMS growth model was used to "grow" the old plot and tree data to produce an estimate of current data. Thus, these plots were treated as ground plots, even though they were never visited. The plot record for each modeled plot was sent to the field for verification of current ownership information.

All old plots classified as disturbed were sent to the field for remeasurement to assess and verify changes since the last inventory. Disturbance refers to any change on a plot that can be detected on aerial photos and that the STEMS growth processor cannot predict, such as catastrophic mortality, cutting, seedling stands, and land use change.

The estimation procedure for computing statistics from this sampling design was more complicated than the simple two-phase estimation procedure used in the past. In fact, this procedure yielded two independent samples, one coming from the new photo points and the other from the old photo points that are remeasured or modeled. The following tabulation summarizes the distribution of all ground plots for the new inventory design by type of plot:

Ground land use class	Old plots remeasured	Old plots updated	New plots	Total plots
Timberland	2,575	1,410	1,036	5,021
Reserved forest land	3	1	16	20
Other forest land	111	124	61	296
Nonforest with trees	146	59	47	252
Nonforest without trees	1,189	1,776	661	3,626
Water	222	386	301	909
Total	4,246	3,756	2,122	10,124

3. Area estimates

Area estimates were made using two-phase estimation methods. In this type of estimation, a preliminary estimate of area by land use is made from the aerial photographs (Phase 1) and corrected by the plot measurements (Phase 2). A complete description of this estimation method is presented by Loetsch and Haller (1964)[4].

Area estimates within the Chippewa National Forest were determined in the same way as other lands but were verified by comparison with National Forest compartment examination records maintained by the Forest Timber Management Staff. This is an intensive area inventory system in which, over a period of years, each stand in the Forest is mapped on aerial photographs and then classified by ground visits.

4. Volume estimates

Estimates of volume per acre were made from the trees measured or modeled on the 10-point plots. Estimates of volume per acre were multiplied by the area estimates to obtain estimates of total volume. Net cubic foot volumes are based on a modification of the method presented by Hahn (1984)[5] for use in the Lake States. For the Minnesota inventory, the merchantable height equation presented was used in conjunction with Stone's equation to estimate gross volume. This estimate was then corrected by species for variation in bark and cull volume to yield an estimate of net volume.

The Forest Service reports all board foot volume in International 1/4-inch rule. In Minnesota, the Scribner log rule is commonly used.

Scribner log rule conversion factors were derived from full tree measurements taken throughout the Lake States (Michigan, Wisconsin, and Minnesota) and an equation developed by Wiant and Castenaeda (1977)[6]. The factors (multipliers) used here to convert board foot International volumes to the Scribner rule are shown in the following tabulation:

D.B.H. (inches)	Scribner rule conversion factor	
	Softwoods	Hardwoods
9.0-10.9	0.7830	—
11.0-12.9	.8287	0.8317
13.0-14.9	.8577	.8611
15.0-16.9	.8784	.8827
17.0-18.9	.8945	.8999
19.0-20.9	.9079	.9132
21.0-22.9	.9168	.9239
23.0-24.9	.9240	.9325
25.0-26.9	.9299	.9396
27.0-28.9	.9321	.9454
29.0+	.9357	.9544

5. Growth and mortality estimates

On remeasured plots, estimates of growth and mortality per acre come from the remeasured diameters of trees and from observation of trees that died between inventories. Growth reported as the average net annual growth between the two inventories (1977 and 1990) is computed from data on remeasurement plots and modeled plots using methods presented by VanDeusen *et al.* (1986)[7]. Mortality is also average net annual for the remeasurement period. On new plots, where trees were not remeasured, estimates of growth and mortality were obtained by using STEMS to project the growth and mortality of trees for 1 year. Growth and mortality estimates for old undisturbed plots that were updated were derived in the same manner as

[4] *Loetsch, F.; Haller, K.E. 1964. Forest inventory, volume I, statistics of forest inventory and information from aerial photographs. BLV Verlagsgesellschaft Munch Basle Vienna. 436 p.*

[5] *Hahn, Jerold T. 1984. Tree volume and biomass equations for the Lake States. Res. Pap. NC-250. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 10 p.*

[6] *Wiant, Harry V., Jr.; Castenaeda, Froylan. 1977. Mesavage and Girard's volume tables formulated. BLM4. Denver, CO: U.S. Department of Interior, Bureau of Land Management, Denver Service Center: 1-4.*

[7] *VanDeusen, P.C.; Dell, T.R.; Thomas, C.E. 1986. Volume growth estimation from permanent horizontal points. Forest Science. 32: 415-422.*

remeasured plots. The STEMS growth model was adjusted by Survey Unit to meet local conditions, using data from the undisturbed remeasurement plots. As with volume, total growth and mortality estimates were obtained by multiplying the per acre estimates by area estimates. Current annual growth for 1989 was computed by using the adjusted STEMS model to grow all current inventory plots for 1 year.

6. Average annual removals estimates

Average annual growing-stock and sawtimber removals (1977 to 1989) were estimated only from the remeasured plots; new plots were not used to estimate removals. These estimates are obtained from trees measured in the last survey and cut or otherwise removed from the timberland base. Because remeasurement plots make up about one-half of the total ground plots, average annual removals estimates have greater sampling errors than volume and growth estimates.

COMPARING MINNESOTA'S FIFTH INVENTORY WITH THE FOURTH INVENTORY

The following paragraphs highlight some of the procedural changes since the last inventory to assist the reader in analyzing data from this report:

A new volume estimation procedure was developed for the Lake States (see Survey Procedures section), and this procedure was used to compute the 1989 volumes and also to recompute the 1977 volume for growth calculations. Although the adjustment will differ by Survey Unit and species, the recomputed 1977 growing-stock and board foot volumes will generally be greater than those shown in the 1977 report.

Past surveys used only growing-stock trees to determine stand-size class. Current survey procedures require that stand-size class be determined on the basis of all live trees. Therefore, direct comparisons of current inventory data to old inventory data by stand-size class may be misleading.

The basic building block for estimating forest area and timber volume has been changed from the Survey Unit to the county. In the past, the statistics were developed at the Unit level and prorated back to the county on the basis of photo-interpretation points. Direct development of county-level data helps users interested in more precise local data, but can make the outcome of comparisons with past estimates uncertain.

LOG GRADE

In Minnesota the butt log of every sawtimber sample tree was graded for quality on approximately one-third of the sample plots. The volume yield by log grade for species in this sample was used to distribute the volume of trees in the ungraded sample into log-grade classes by species group.

Logs were graded on the basis of external characteristics as indicators of quality. Hardwood species were graded according to "A guide to hardwood log grading" 1973[8]. The best 12-foot section of the lowest 16-foot hardwood log, or the best 12-foot upper section if the butt log did not meet minimum log-grade standards, was graded as follows:

[8] *Rast, Everette D.; Sonderman, David L.; Gammon, Glenn L. 1973. A guide to hardwood log grading. Gen. Tech. Rep. NE-1. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 31 p.*

Forest Service standard grades for hardwood factory saw logs

Grading Factors		Specifications							
		Log grade 1			Log grade 2				Log grade 3
Position in tree		Butts only	Butts & uppers		Butts & uppers				Butts & uppers
Scaling diameter, inches		13-15[1]	16-19	20+	11+[2]		12+		8+
Length without trim, feet			10+		10+	8-9	10-11	12+	8+
Required clear cuttings[3] of each of three best faces[4]	Min. length, feet	7	5	3	3	3	3	3	2
	Max. number		2	2	2	2	2	3	No limit
	Min. proportion of log length required in clear cutting	5/6	5/6	5/6	2/3	3/4	2/3	2/3	1/2
Maximum sweep & crook allowance	For logs with less than one-fourth of end in sound defects		15 percent				30 percent		50 percent
	For logs with more than one-fourth of end in sound defects		10 percent				20 percent		35 percent
Maximum scaling deduction			40 percent[5]				50 percent[6]		50 percent

[1] *Ash and basswood butts can be 12 inches if they otherwise meet requirements* for small #1's.
[2] *Ten-inch logs of all species can be #2 if they otherwise meet requirements for small #1's.*
[3] *A clear cutting is a portion of a face, extending the width of the face, that is free of defects.*
[4] *A face is one-fourth of the surface of the log as divided lengthwise.*
[5] *Otherwise #1 logs with 41-60 percent deductions can be #2.*
[6] *Otherwise #2 logs with 51-60 percent deductions can be #3.*

Forest Service standard specifications for hardwood construction logs (tie and timber logs)[1]

Position in tree	Butts and uppers
Min. diameter, small end	8 inches +
Min. length without trim	8 feet
Clear cuttings	No requirements
Sweep allowance	One-fourth of the diameter at the small end for each 8 feet of length.
Sound surface defects:	
Single knots	Any number, if no one knot has an average diameter above the callus in excess of one-third of the log diameter at point of occurrence.
Whorled knots	Any number, if the sum of knot diameters above the callus does not exceed one-third of the log diameter at point of occurrence.
Holes	Any number, provided none has a diameter over one-third of the log diameter at point of occurrence and none extends more than 3 inches into included timber[2].
Unsound surface defects :	Same requirements as for sound defects if they extend into included timber. No limit if they do not.

[1]These specifications are minimum for the class. If, from a group of logs, factory logs are selected first, thus leaving only nonfactory logs from which to select construction logs, then the quality range of the construction logs so selected is limited, and the class may be considered a grade. If selection for construction logs is given first priority, it may be necessary to subdivide the class into grades.

[2]Included timber is always square, and dimension is judged from small end.

LOG GRADES FOR EASTERN WHITE PINE

Log grade	Minimum size [1] Diameter (Inches)	Length (Feet)	Sweep or crook allowance (Percent)	Total cull allowance including sweep (Percent)	Maximum weevil injury (Number)	Allowable knot size(inches)[2] on three best faces or minimum clearness on four faces (Inches)
1	12 & 13	8-16	20	50	0	Four faces clear full length
	14+	10-16	20	50	0	Two faces clear full length, or four faces clear 50 percent length (6 feet min. length)[3]
2	6+	8-16	30	50	0	Sound knots l.e[4] D/6 and less than 3 inches[5] Unsound knots: l.e.1-1/2 inches and for: butt, logs l.e. D/12 upper logs l.e.D/10, or four faces clear 50 percent of length
3	6+	8-16	40	50	8-foot logs: 1 weevil 10-foot+ logs: 2 weevils	Sound knots l.e.D/3 and less than 5 inches Unsound knots l.e. D/6 and less than 2-1/2 inches
4	6+	8-16	50	50	No limit	No limit

[1] *Plus trim.*

[2] *Disregard all knots less than 1/2-inch diameter in all grades.*

[3] *The sum of the diameter of sound knots plus twice the sum of the diameter of unsound knots (in inches) is less than or equal to half of the diameter of the log (inches).*

[4] *l.e. means less than or equal to.*

[5] *D means d.i.b. of log at location of knot.*

LOG GRADES FOR JACK PINE AND RED PINE

Grade 1: Logs with three or four clear faces.[1]

Grade 2: Logs with one or two clear faces.

Grade 3: Logs with no clear faces.

After the tentative log grade is established from above, the log will be degraded one grade for each of the following, except that no log can be degraded below grade 3. Net scale after deduction for defect must be at least 50 percent of the gross contents of the log.

1. *Sweep.* Degrade any tentative 1 or 2 log one grade if sweep amounts to 3 or more inches and equals or exceeds one-third of the diameter inside bark at small end.

2. *Heart rot.* Degrade any tentative 1 or 2 log one grade if conk, massed hyphae, or other evidence of advanced heart rot is found anywhere in it.

[1]*A face is one-fourth of the circumference in width extending full length of the log. Clear faces are those free of: knots measuring more than 1/2-inch in diameter, overgrown knots of any size, and holes more than 1/4-inch in diameter. Faces may be rotated to obtain the maximum number of clear ones.*

LOG GRADES FOR ALL OTHER SOFTWOOD LOGS

Grade 1

1. Logs must be 16 inches in diameter or larger, 10 feet in length or longer, and with deduction for defect not over 30 percent of gross scale.

2. Logs must be at least 75 percent clear on each of three faces.

3. All knots outside clear cutting must be sound and not more than 2-1/2 inches in size.

Grade 2

1. Logs must be 12 inches in diameter or larger, 10 feet in length or longer, and with a net scale after deduction for defect of at least 50 percent of the gross scale deducted for defect.

2. Logs must be at least 50 percent clear on each of three faces or 75 percent clear on two faces.

Grade 3

1. Logs must be 6 inches in diameter or larger, 8 feet in length or longer, and with a net scale after deduction for defect of at least 50 percent of the gross contents of the log.

Note: *A) Diameters are diameter inside bark (d.i.b.) at small end of log.*
B) Percent clear refers to percent clear in one continuous section.

METRIC EQUIVALENTS OF UNITS USED IN THIS REPORT

1 acre = 4,046.86 square meters or 0.405 hectare.
1,000 acres = 405 hectares.
1 cubic foot = 0.0283 cubic meter.
1 foot = 30.48 centimeters or 0.3048 meter.
1 inch = 25.4 millimeters, 2.54 centimeters, or 0.0254 meter.
1 pound = 0.454 kilograms.
1 ton = 0.907 metric tons.

TREE SPECIES GROUPS IN MINNESOTA[9]

SOFTWOODS
Eastern white pine ..... *Pinus strobus*
Red pine ..... *Pinus resinosa*
Jack pine ..... *Pinus banksiana*
White spruce ..... *Picea glauca*
Black spruce ..... *Picea mariana*
Balsam fir ..... *Abies balsamea*
Tamarack ..... *Larix laricina*
Northern white-cedar ..... *Thuja occidentalis*
Other softwoods
  Eastern redcedar ..... *Juniperus virginiana*
  Scotch pine ..... *Pinus sylvestris*

HARDWOODS
White oak[10]
  White oak ..... *Quercus alba*
  Bur oak ..... *Quercus macrocarpa*
Red oak[10]
  Northern red oak ..... *Quercus rubra*
  Northern pin oak ..... *Quercus ellipsoidalis*
  Black oak ..... *Quercus velutina*
Hickory[10]
  Shagbark hickory ..... *Carya ovata*
  Bitternut hickory ..... *Carya cordiformis*
Yellow birch[10] ..... *Betula alleghaniensis*
Hard maple[10]
  Black maple ..... *Acer nigrum*
  Sugar maple ..... *Acer saccharum*
Soft maple[11]
  Red maple ..... *Acer rubrum*
  Silver maple ..... *Acer saccharinum*
Ash[10]
  Black ash ..... *Fraxinus nigra*
  Green ash ..... *Fraxinus pennsylvanica*
Balsam poplar[11] ..... *Populus balsamifera*
Aspen
  Bigtooth aspen[11] ..... *Populus grandidentata*
  Quaking aspen[11] ..... *Populus tremuloides*
Cottonwood[11] ..... *Populus deltoides*
Basswood[11] ..... *Tilia americana*
Black walnut[10] ..... *Juglans nigra*
Black cherry[11] ..... *Prunus serotina*
Butternut[11] ..... *Juglans cinerea*
Elm
  American elm[11] ..... *Ulmus americana*
  Slippery elm[11] ..... *Ulmus rubra*
  Rock elm[10] ..... *Ulmus thomasii*
Paper birch[11] ..... *Betula papyrifera*
Hackberry[11] ..... *Celtis occidentalis*
Black willow[11] ..... *Salix nigra*
Other hardwoods
  Boxelder[11] ..... *Acer negundo*
  Black locust[10] ..... *Robinia pseudoacacia*
  Red mulberry[11] ..... *Morus rubra*
  Honeylocust[10] ..... *Gleditsia triacanthos*
  Northern catalpa[10] ..... *Catalpa speciosa*
Noncommercial species
  Eastern hophornbeam ..... *Ostrya virginiana*
  Apple ..... *Malus* spp.
  American hornbeam ..... *Carpinus caroliniana*
  Wild plum ..... *Prunus* spp.
  Hawthorn ..... *Crataegus* spp.

[9] *The common and scientific names are based on: Little, Elbert L. 1981. Checklist of native and naturalized trees of the United States. Agric. Handb. 541. Washington, DC: U.S. Department of Agriculture, Forest Service. 385 p.*

[10] *This species or species group is considered a hard hardwood, with an average specific gravity greater than or equal to 0.50.*

[11] *This species or species group is considered a soft hardwood, with an average specific gravity of less than 0.50.*

DEFINITION OF TERMS

Average annual removals from growing stock.—The average net growing-stock volume in growing-stock trees removed annually for forest products (including roundwood products and logging residues) and for other uses (see Other removals). Average annual removals of growing stock are reported for a period of several years (1977 to 1989 in this report) and are based on information obtained from remeasurement plots (see Survey Procedures in Appendix).

Average annual removals from sawtimber.—The average net board foot sawtimber volume of live sawtimber trees removed annually for forest products (including roundwood products and other uses [see Other removals]). Average annual removals of sawtimber are reported for a period of several years (1977 to 1989 in this report) and are based on information obtained from remeasurement plots (see Survey Procedures in Appendix).

Commercial species.—Tree species presently or prospectively suitable for industrial wood products. (Note: Excludes species of typically small size, poor form, or inferior quality such as hophornbeam, osage-orange, and redbud.)

Commercial forest land.—(See Timberland).

Cord.—One standard cord is 128 cubic feet of stacked wood, including bark and air space. Cubic feet can be converted to standard cords by dividing by 79.

County and municipal land.—Land owned by counties and local public agencies or municipalities, or land leased to these governmental units for 50 years or more.

Cull.—Portions of a tree that are unusable for industrial wood products because of rot, missing or dead material, or other defect.

Current annual growth of growing stock.—The annual change in volume of sound wood in live sawtimber and poletimber trees and the total volume of trees entering these classes through ingrowth, less volume losses resulting from natural causes. Current growth is based on an estimate of the current annual increment of each growing stock tree in the inventory.

Current annual growth of sawtimber.—The annual change in the volume of live sawtimber trees and the total volume of trees reaching sawtimber size, less volume losses resulting from natural causes. Current growth is based on an estimate of the current annual increment of each growing-stock tree in the inventory.

Current annual removals from growing stock.—The current net growing-stock volume in growing-stock trees removed annually for forest products (including roundwood products and logging residues) and for other uses (see Other removals). Current annual removals of growing stock are reported for a single year (1988 in this report) and are based on a survey of primary wood processing mills to determine removals for products and on information from remeasurement plots (see Survey Procedures in Appendix) to determine removals due to land use change.

Current annual removals from sawtimber.—The current net board foot sawtimber volume of live sawtimber trees removed annually for forest products (including roundwood products and other uses [see Other removals]). Current annual removals of sawtimber are reported for a single year (1988 in this report) and are based on a survey of primary wood processing mills to determine removals for products and on information from remeasurement plots (see Survey Procedures in Appendix) to determine removals due to land use change.

Diameter class.—A classification of trees based on diameter outside bark, measured at breast height (d.b.h.). Two-inch diameter classes are commonly used in Forest Inventory and Analysis, with the even inch the approximate midpoint for a class. For example, the 6-inch class includes trees 5.0 through 6.9 inches d.b.h.

Diameter at breast height (d.b.h.).—The outside bark diameter at 4.5 feet (1.37 m) above the forest floor on the uphill side of the tree. For determining breast height, the forest floor includes the duff layer that may be present, but does not include unincorporated woody debris that may rise above the ground line.

Farm.—Any place from which $1,000 or more of agricultural products were produced and sold during the year.

Farmer-owned land.—Land owned by farm operators whether part of the farmstead or not. (Note: Excludes land leased by farm operators from nonfarm owners, such as railroad companies and States.)

Forest land.—Land at least 16.7 percent stocked by forest trees of any size, or formerly having such tree cover, and not currently developed for nonforest use. (Note: Stocking is measured by comparing specified standards with basal area and/or number of trees, age or size, and spacing.) The minimum area for classification of forest land is 1 acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width of at least 120 feet to qualify as forest land. Unimproved roads and trails, streams, or other bodies of water or clearings in forest areas shall be classed as forest if less than 120 feet wide. (See Tree, Land, Timberland, Reserved forest land, Other forest land, Stocking, and Water.)

Forest industry land.—Land owned by companies or individuals that operate a primary wood-using plant.

Forest type.—A classification of forest land based on the species forming a plurality of live tree stocking. Major forest types in the State are:

Jack pine.—Forests in which jack pine comprises a plurality of the stocking. (Common associates include eastern white pine, red pine, aspen, birch, and maple.)

Red pine.—Forests in which red pine comprises a plurality of the stocking. (Common associates include eastern white pine, jack pine, aspen, birch, and maple.)

White pine.—Forests in which eastern white pine comprises a plurality of the stocking. (Common associates include red pine, jack pine, aspen, birch, and maple.)

Balsam fir.—Forests in which balsam fir and white spruce comprise a plurality of stocking with balsam fir the most common. (Common associates include aspen, maple, birch, northern white-cedar, and tamarack.)

White spruce.—Forests in which white spruce and balsam fir comprise a plurality of the stocking with white spruce the most common. (Common associates include aspen, maple, birch, northern white-cedar, and tamarack.)

Black spruce.—Forests in which swamp conifers comprise a plurality of the stocking with black spruce the most common. (Common associates include tamarack and northern white-cedar.)

Northern white-cedar.—Forests in which swamp conifers comprise a plurality of the stocking with northern white-cedar the most common. (Common associates include tamarack and black spruce.)

Tamarack.—Forests in which swamp conifers comprise a plurality of the stocking with tamarack the most common. (Common associates include black spruce and northern white-cedar.)

Oak-hickory.—Forests in which northern red oak, white oak, bur oak, or hickories, singly or in combination, comprise a plurality of the stocking. (Common associates include jack pine, elm, and maple.)

Elm-ash-soft maple.—Forests in which lowland elm, ash, red maple, silver maple, and cottonwood, singly or in combination, comprise a plurality of the stocking. (Common associates include birches, spruce, and balsam fir.)

Maple-basswood.—Forests in which sugar maple, basswood, yellow birch, upland American elm, and red maple, singly or in combination, comprise a plurality of the stocking. (Common associates include white pine, elm, and basswood.)

Aspen.—Forests in which quaking aspen or bigtooth aspen, singly or in combination, comprise a plurality of the stocking. (Common associates include balsam poplar, balsam fir, and paper birch.)

Paper birch.—Forests in which paper birch comprises a plurality of the stocking. (Common associates include maple, aspen, and balsam fir.)

Balsam poplar.—Forests in which balsam poplar comprises a plurality of the stocking. (Common associates include aspen, elm, and ash.)

Growing-stock tree.—A live tree of commercial species that meets specified standards of size, quality, and merchantability. (Note: Excludes rough, rotten, and dead trees.)

Growing-stock volume.—Net volume in cubic feet of growing-stock trees 5.0 inches d.b.h. and over, from 1 foot above the ground to a minimum 4.0 inch top diameter outside bark of the central stem or to the point where the central stem breaks into limbs.

Hard hardwoods.—Hardwood species with an average specific gravity greater than 0.50 such as oaks, hard maple, hickories, and ash.

Hardwoods.—Dicotyledonous trees, usually broad-leaved and deciduous. (See Soft hardwoods and Hard hardwoods.)

Indian land.—Land held in trust by the United States for the tribes or individual indians.

Land.—*A. Bureau of the Census.* Dry land and land temporarily or partly covered by water such as marshes, swamps, and river flood plains (omitting tidal flats below mean high tide); streams, sloughs, estuaries, and canals less than one-eighth of a statute mile wide; and lakes, reservoirs, and ponds less than 40 acres in area.

B. Forest Inventory and Analysis. The same as the Bureau of the Census, except minimum width of streams, etc., is 120 feet and minimum size of lakes, etc., is 1 acre.

Log grade.—A log classification based on external characteristics as indicators of quality or value. (See Appendix for specific grading factors used.)

Marsh.—Nonforest land that characteristically supports low, generally herbaceous or shrubby vegetation and that is intermittently covered with water.

Merchantable.—Refers to a pulpwood or saw-log section that meets pulpwood or saw-log specifications, respectively.

Miscellaneous Federal land.—Federal land other than National Forest and land administered by the Bureau of Land Management or Bureau of Indian Affairs.

Miscellaneous private land.—Privately owned land other than forest-industry and farmer-owned land.

Mortality.—The volume of sound wood in growing-stock and sawtimber trees that die annually.

National Forest land.—Federal land that has been legally designated as National Forest or purchase units, and other land administered by the USDA Forest Service.

Net annual growth of growing stock.— The annual change in volume of sound wood in live sawtimber and poletimber trees and the total volume of trees entering these classes through ingrowth, less volume losses resulting from natural causes.

Net annual growth of sawtimber.—The annual change in the volume of live sawtimber trees and the total volume of trees reaching sawtimber size, less volume losses resulting from natural causes.

Net volume.—Gross volume less deductions for rot, sweep, or other defect affecting use for timber products.

Noncommercial species.—Tree species of typically small size, poor form, or inferior quality that normally do not develop into trees suitable for industrial wood products.

Nonforest land.—Land that has never supported forests, and land formerly forested where use for timber management is precluded by development for other uses. (Note: Includes areas used for crops, improved pasture, residential areas, city parks, improved roads of any width and adjoining clearings, powerline clearings of any width, and 1- to 40-acre areas of water classified by the Bureau of the Census as land. If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120 feet wide and more than 1 acre in area to qualify as nonforest land.)

a. Nonforest land without trees.—Nonforest land with no live trees present.

b. Nonforest land with trees.—Nonforest land with one or more trees per acre at least 5 inches d.b.h.

Nonstocked land.—Forest land less than 16.7 percent stocked with all live trees.

Other forest land.—Forest land not capable of producing 20 cubic feet per acre per year of industrial wood crops under natural conditions and not associated with urban or rural development. These sites often contain tree species that are not currently utilized for industrial wood production or trees of poor form, small size, or inferior quality that are unfit for industrial products. Unproductivity may be the result of adverse site conditions such as sterile soil, dry climate, poor drainage, high elevation, and rockiness. This land is not withdrawn from timber utilization.

Other removals.—Growing-stock trees removed but not utilized for products, or trees left standing but "removed" from the timberland classification by land use change. Examples are removals from cultural operations such as timber stand improvement work, land clearing, and changes in land use.

Poletimber stand.—(See Stand-size class.)

Poletimber tree.—A tree of commercial species at least 5.0 inches d.b.h. but smaller than sawtimber size.

Potential productivity class.—A classification of forest lands in terms of inherent capacity to grow crops of industrial wood. The class identifies the potential growth in merchantable cubic feet/acre/year at culmination of mean annual increment of fully stocked natural stands.

Reserved forest land.—Forest land withdrawn from timber utilization through statute, administrative regulation, designation, or exclusive use for Christmas tree production, as indicated by annual shearing.

Rotten tree.—A tree that does not meet regional merchantability standards because of excessive unsound cull. May include noncommercial tree species.

Rough tree.—A tree that does not meet regional merchantability standards because of excessive sound cull. May include noncommercial tree species.

Salvable dead tree.—A standing or down dead tree considered merchantable by regional standards.

Sapling.—A live tree 1.0 to 5.0 inches d.b.h.

Sapling-seedling stand.—(See Stand-size class.)

Saw log.—A log meeting minimum standards of diameter, length, and defect, including logs at least 8 feet long, sound and straight and with a minimum diameter outside bark (d.o.b.) for softwoods of 7.0 inches (9.0 inches for hardwoods) or other combinations of size and defect specified by regional standards.

Saw-log portion.—That part of the bole of sawtimber trees between the stump and the saw-log top.

Saw-log top.—The point on the bole of sawtimber trees above which a saw log cannot be produced. The minimum saw-log top is 7.0 inches d.o.b. for softwoods and 9.0 inches d.o.b. for hardwoods.

Sawtimber stand.—(See Stand-size class.)

Sawtimber tree.—A tree of commercial species containing at least a 12-foot saw log or two noncontiguous saw logs 8 feet or longer, and meeting regional specifications for freedom from defect. Softwoods must be at least 9.0 inches d.b.h. Hardwoods must be at least 11.0 inches d.b.h.

Sawtimber volume.—Net volume of the saw-log portion of live sawtimber in board feet, International 1/4-inch rule (unless specified otherwise) from stump to a minimum 7 inches top diameter outside bark (d.o.b.) for softwoods and a minimum 9 inches top d.o.b. for hardwoods.

Seedling.—A live tree less than 1.0 inch d.b.h. that is expected to survive. Only softwood seedlings more than 6 inches tall and hardwood seedlings more than 1 foot tall are counted.

Short-log (rough tree).—Sawtimber-size trees of commercial species that contain at least one merchantable 8- to 11-foot saw log but not a 12-foot saw log.

Site index.—An expression of forest site quality based on the height of a free-growing dominant or codominant tree of a representative species in the forest type at age 50.

Soft hardwoods.—Hardwood species with an average specific gravity less than 0.50 such as gum, yellow-poplar, cottonwood, red maple, basswood, and willow.

Softwoods.—Coniferous trees, usually evergreen, having needles or scale-like leaves.

Stand.—A group of trees on a minimum of 1 acre of forest land that is stocked by forest trees of any size.

Stand-size class.—A classification of stocked (see Stocking) forest land based on the size class of live trees on the area; that is, sawtimber, poletimber, or seedlings and saplings.

a. Sawtimber stands.—Stands with half or more of live stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking.

b. Poletimber stands.—Stands with half or more live stocking in poletimber and/or sawtimber trees, and with poletimber stocking exceeding that of sawtimber.

c. Sapling-seedling stands.—Stands with more than half of the live stocking in saplings and/or seedlings.

State land.—Land owned by States or leased to them for 50 years or more.

Stocking.—The degree of occupancy of land by live trees, measured by basal area and/or the number of trees in a stand by size or age and spacing, compared to the basal area and/or number of trees required to fully utilize the growth potential of the land; that is, the stocking standard.

A stocking percent of 100 indicates full utilization of the site and is equivalent to 80 square feet of basal area per acre in trees 5.0 inches d.b.h. and larger. In a stand of trees less than 5 inches d.b.h., a stocking percent of 100 would indicate that the present number of trees is sufficient to produce 80 square feet of basal area per acre when the trees reach 5 inches d.b.h.

Stands are grouped into the following stocking classes:

Overstocked stands.—Stands in which stocking of live trees is 133 percent or more.

Fully stocked stands.—Stands in which stocking of live trees is from 100.0 to 132.9 percent.

Medium stocked stands.—Stands in which stocking of live trees is from 60.0 to 99.9 percent.

Poorly stocked stands.—Stands in which stocking of live trees is from 16.7 to 59.9 percent.

Nonstocked areas.—Timberland on which stocking of live trees is less than 16.7 percent.

Timberland.—Forest land that is producing or capable of producing in excess of 20 cubic feet per acre per year of industrial wood crops under natural conditions, that is not withdrawn from timber utilization, and that is not associated with urban or rural development. Currently inaccessible and inoperable areas are included.

Tree.—A woody plant usually having one or more perennial stems, a more or less definitely formed crown of foliage, and a height of at least 12 feet at maturity.

Tree size class.—A classification of trees based on diameter at breast height, including sawtimber trees, poletimber trees, saplings, and seedlings.

Upper stem portion.—That part of the bole of sawtimber trees above the saw-log top to a minimum top diameter of 4.0 inches outside bark or to the point where the central stem breaks into limbs.

Water.—(a) *Bureau of the Census.*—Permanent inland water surfaces, such as lakes, reservoirs, and ponds at least 40 acres in area; and streams, sloughs, estuaries, and canals at least one-eighth of a statute mile wide.

(b) *Noncensus.*—Permanent inland water surfaces, such as lakes, reservoirs, and ponds from 1 to 39.9 acres in area; and streams, sloughs, estuaries, and canals from 120 feet to one-eighth of a statute mile wide.

Wooded strip.—An acre or more of natural continuous forest land that would otherwise meet survey standards for timberland except that it is less than 120 feet wide.

TABLES

Table 1.—Area of land by county and major land-use class, Northern Pine Unit, Minnesota, 1990

Table 2.—Area of timberland by county and ownership class, Northern Pine Unit, Minnesota, 1990

Table 3.—Area of timberland by county and forest type, Northern Pine Unit, Minnesota, 1990

Table 4.—Area of timberland by county and stand-size class, Northern Pine Unit, Minnesota, 1990

Table 5.—Area of timberland by county and potential productivity class, Northern Pine Unit, Minnesota, 1990

Table 6.—Area of timberland by county and stocking class of growing-stock trees, Northern Pine Unit, Minnesota, 1990

Table 7.—Area of timberland by ownership class and stocking class of growing-stock trees, Northern Pine Unit, Minnesota, 1990

Table 8.—Area of timberland by forest type and ownership class, Northern Pine Unit, Minnesota, 1990

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Table 10.—Number of all live trees on timberland by species group and diameter class, Northern Pine Unit, Minnesota, 1990

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Table 15.—Net volume of sawtimber trees on timberland by species group and diameter class, Northern Pine Unit, Minnesota, 1990

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Table 24.—Current annual growth, mortality, and removals of growing stock and sawtimber on timberland by species group, Northern Pine Unit, Minnesota, 1989

Table 1.--Area of land by county and major land-use class, Northern Pine Unit, Minnesota, 1990

(In thousand acres)

County	Land area	Forest land				
		All forest land	Timber-land	Timberland as a percent of land area	Other forest land	Reserved forest land
Aitkin	1,173.6	760.2	710.9	60.6	50.4	1.0
Becker	839.7	335.3	332.3	39.6	2.6	3.0
Beltrami	1,604.5	929.7	841.8	52.5	85.0	2.9
Cass	1,301.2	868.6	841.6	64.7	28.0	1.6
Clearwater	639.7	321.7	289.4	45.2	16.1	18.7
Crow Wing	644.8	388.9	386.7	60.0	4.8	--
Hubbard	598.8	407.9	399.8	66.8	2.2	5.9
Itasca	1,703.4	1,362.4	1,324.4	77.8	41.8	0.8
Lake of the Woods	829.6	500.3	398.4	48.0	104.1	--
Mahnomen	357.8	116.6	113.9	31.8	1.1	1.6
Roseau	1,073.3	225.7	217.2	20.2	9.8	--
Wadena	344.1	119.1	119.1	34.6	--	--
All counties	11,110.5	6,336.4	5,975.5	53.8	345.9	35.5

Table 2.--Area of timberland by county and ownership class, Northern Pine Unit, Minnesota, 1990

(In thousand acres)

County	All owners	Ownership class									
		National forest	Bureau of Land Mgmt.	Misc. federal	State	County & municipal	Indian	Forest industry	Farmer	Misc. private corporation	Misc. private individual
Aitkin	710.9	--	--	7.9	255.9	197.8	--	11.3	71.3	6.3	160.4
Becker	332.3	--	--	26.2	20.2	87.6	2.3	4.7	69.5	6.0	115.8
Beltrami	841.8	57.8	--	--	246.1	140.0	203.9	2.0	78.6	8.4	105.0
Cass	841.6	241.1	--	3.0	104.7	232.9	18.4	32.4	43.5	15.3	150.3
Clearwater	289.4	--	--	2.6	25.8	66.8	57.0	2.9	70.9	2.7	60.7
Crow Wing	386.7	--	--	--	20.4	89.6	--	16.5	39.4	27.7	193.1
Hubbard	399.8	--	--	0.9	52.1	121.2	--	21.5	31.4	8.0	164.7
Itasca	1,324.4	268.3	--	--	253.8	255.7	2.3	169.0	38.0	71.3	266.0
Lake of the Woods	398.4	--	12.6	7.9	230.6	3.1	75.2	2.2	14.6	3.1	49.1
Mahnomen	113.9	--	--	11.3	23.6	5.7	16.6	--	42.2	--	14.5
Roseau	217.2	--	--	10.7	123.9	3.4	4.9	--	55.5	3.2	15.6
Wadena	119.1	--	--	--	13.4	0.8	--	22.5	41.8	3.3	37.3
All counties	5,975.5	567.2	12.6	70.5	1,370.5	1,204.6	380.6	285.0	596.7	155.3	1,332.5

Table 3.--Area of timberland by county and forest type, Northern Pine Unit, Minnesota, 1990

(In thousand acres)

County	All types	Forest type														
		Jack pine	Red pine	White pine	Balsam fir	White spruce	Black spruce	Northern white-cedar	Tamarack	Oak-hickory	Elm-ash-soft maple	Maple-bass-wood	Aspen	Paper birch	Balsam poplar	Non-stocked
Aitkin	710.9	1.3	9.5	--	15.0	1.5	56.7	18.8	81.1	25.5	92.9	127.8	220.2	36.3	9.0	15.3
Becker	332.3	14.0	3.4	1.2	9.4	--	3.0	--	19.8	46.7	20.6	49.8	144.8	16.7	0.7	2.2
Beltrami	841.8	32.5	27.7	1.2	17.3	3.7	48.1	59.7	83.7	16.2	71.7	56.9	308.1	34.7	66.1	14.2
Cass	841.6	50.7	51.9	6.0	17.5	5.0	16.5	40.9	35.6	50.2	49.3	66.8	360.0	71.2	14.8	5.2
Clearwater	289.4	5.6	6.9	0.9	11.4	--	6.5	7.8	10.6	7.3	19.4	31.1	143.8	14.3	19.6	4.2
Crow Wing	386.7	34.6	10.7	2.3	0.8	--	9.2	0.9	15.0	77.9	38.1	23.6	148.0	22.8	--	2.8
Hubbard	399.8	59.4	23.3	2.3	14.1	3.1	5.2	0.9	11.0	14.1	21.9	15.1	199.1	24.7	3.3	2.3
Itasca	1,324.4	30.9	48.3	6.9	81.7	16.5	119.9	68.5	68.4	12.1	128.3	83.2	522.0	82.1	47.7	7.9
Lake of the Woods	398.4	23.1	4.7	--	14.3	3.3	69.3	33.6	53.8	1.8	11.5	--	123.9	10.1	29.7	19.3
Mahnomen	113.9	--	--	--	0.9	1.1	--	--	1.0	17.6	7.7	33.9	45.0	3.1	1.8	1.8
Roseau	217.2	22.3	3.6	--	4.0	1.8	13.8	5.4	20.5	1.0	19.7	--	90.4	--	32.5	2.2
Wadena	119.1	29.5	15.3	3.5	0.9	--	--	--	3.3	22.1	6.9	1.4	33.6	1.3	1.3	--
All counties	5,975.5	303.9	205.3	24.3	187.3	36.0	348.2	236.5	403.8	292.5	488.0	489.6	2,338.9	317.3	226.5	77.4

Table 4.--Area of timberland by county and stand-size class, Northern Pine Unit, Minnesota, 1990

(In thousand acres)

County	All stands	Stand-size class			
		Sawtimber	Poletimber	Seedling & sapling	Nonstocked
Aitkin	710.9	235.2	274.6	185.8	15.3
Becker	332.3	141.8	137.0	51.3	2.2
Beltrami	841.8	253.4	321.5	252.7	14.2
Cass	841.6	319.2	314.3	202.9	5.2
Clearwater	289.4	96.5	113.2	75.5	4.2
Crow Wing	386.7	159.2	146.2	78.5	2.8
Hubbard	399.8	104.0	199.6	93.9	2.3
Itasca	1,324.4	427.4	432.3	456.8	7.9
Lake of the Woods	398.4	90.6	142.7	145.8	19.3
Mahnomen	113.9	30.5	54.3	27.3	1.8
Roseau	217.2	49.9	76.9	88.2	2.2
Wadena	119.1	34.4	43.6	41.1	--
All counties	5,975.5	1,942.1	2,256.2	1,699.8	77.4

Table 5.--Area of timberland by county and potential productivity class, Northern Pine Unit, Minnesota, 1990

(In thousand acres)

County	All classes	Potential productivity class (cubic feet of growth per acre per year)				
		165+	120-164	85-119	50-84	20-49
Aitkin	710.9	--	6.1	130.8	138.7	435.3
Becker	332.3	--	1.0	56.3	103.3	171.7
Beltrami	841.8	--	7.6	127.7	191.8	514.7
Cass	841.6	1.5	15.1	193.4	270.3	361.3
Clearwater	289.4	--	3.6	76.9	73.7	135.2
Crow Wing	386.7	--	--	35.8	163.0	187.9
Hubbard	399.8	--	4.8	85.1	149.0	160.9
Itasca	1,324.4	1.6	26.7	385.6	266.4	644.1
Lake of the Woods	398.4	--	--	36.5	84.0	277.9
Mahnomen	113.9	--	--	18.3	32.5	63.1
Roseau	217.2	--	1.8	8.7	63.7	143.0
Wadena	119.1	--	3.0	20.8	52.0	43.3
All counties	5,975.5	3.1	69.7	1,175.9	1,588.4	3,138.4

Table 6.--Area of timberland by county and stocking class of growing-stock trees[1], Northern Pine Unit, Minnesota, 1990

(In thousand acres)

County	All classes	Stocking class of growing-stock trees				
		Non-stocked	Poorly stocked	Moderately stocked	Fully stocked	Over-stocked
Aitkin	710.9	18.9	167.7	265.1	176.5	82.7
Becker	332.3	2.2	71.0	158.3	84.9	15.9
Beltrami	841.8	17.1	168.3	305.9	238.1	112.4
Cass	841.6	5.2	119.8	300.7	298.4	117.5
Clearwater	289.4	5.1	67.8	105.3	81.7	29.5
Crow Wing	386.7	3.9	76.4	177.0	93.5	35.9
Hubbard	399.8	2.3	72.4	174.6	108.6	41.9
Itasca	1,324.4	16.2	193.8	492.7	388.5	233.2
Lake of the Woods	398.4	27.0	90.9	124.9	106.0	49.6
Mahnomen	113.9	1.8	18.8	50.0	28.6	14.7
Roseau	217.2	3.6	62.3	70.7	59.7	20.9
Wadena	119.1	--	34.1	63.7	16.9	4.4
All counties	5,975.5	103.3	1,143.3	2,288.9	1,681.4	758.6

[1]This table is based on the stocking percent of growing-stock trees rather than that of all live trees. To use the definitions of stocking for this table, replace the term "live" by "growing-stock."

Table 7.--Area of timberland by ownership class and stocking class of growing-stock trees[1], Northern Pine Unit, Minnesota, 1990

(In thousand acres)

Ownership class	All classes	Stocking class of growing-stock trees				
		Non-stocked	Poorly stocked	Moderately stocked	Fully stocked	Over-stocked
National forest	567.2	2.4	43.9	157.4	224.2	139.3
Bureau of Land Mgmt.	12.6	1.1	4.4	4.4	2.7	--
Miscellaneous federal	70.5	1.8	18.5	35.8	11.1	3.3
State	1,370.5	50.0	288.2	446.5	386.7	199.1
County and municipal	1,204.6	15.6	210.6	467.3	343.2	167.9
Indian	380.6	11.8	86.1	139.0	91.5	52.2
Forest Industry	285.0	3.1	51.3	113.7	82.1	34.8
Farmer	596.7	11.0	157.1	277.2	117.7	33.7
Miscellaneous private corporation	155.3	--	29.5	60.0	47.7	18.1
Miscellaneous private individual	1,332.5	6.5	253.7	587.6	374.5	110.2
All owners	5,975.5	103.3	1,143.3	2,288.9	1,681.4	758.6

[1]This table is based on the stocking percent of growing-stock trees rather than that of all live trees. To use the definitions of stocking for this table, replace the term "live" by "growing-stock."

Table 8.--Area of timberland by forest type and ownership class, Northern Pine Unit, Minnesota, 1990

(In thousand acres)

Forest type	All owners	Ownership class									
		National forest	Bureau of Land Mgmt.	Misc. federal	State	County & municipal	Indian	Forest industry	Farmer	Misc. private corporation	Misc. private individual
Jack pine	303.9	11.7	2.0	2.5	67.1	58.7	5.8	43.3	24.5	5.4	82.9
Red pine	205.3	51.3	0.9	2.2	38.8	36.6	10.9	28.9	6.7	1.9	27.1
White pine	24.3	4.0	--	0.9	1.7	1.4	1.2	--	4.6	2.3	8.2
Balsam fir	187.3	23.6	--	1.3	48.5	49.0	5.9	17.3	15.5	--	26.2
White spruce	36.0	4.9	1.0	--	7.3	7.4	1.1	9.3	--	--	5.0
Black spruce	348.2	37.5	1.1	3.9	166.8	57.7	33.5	8.8	7.0	3.8	28.1
Northern white-cedar	236.5	26.0	1.1	1.3	103.2	32.4	39.2	4.1	4.8	1.1	23.3
Tamarack	403.8	22.6	--	3.0	189.1	65.7	43.8	5.3	24.1	7.2	43.0
Oak-hickory	292.5	7.2	--	10.7	16.5	45.0	6.9	2.8	73.3	13.3	116.8
Elm-ash-soft maple	488.0	33.8	0.7	--	88.6	94.2	30.2	23.9	62.0	9.1	145.5
Maple-basswood	489.6	55.4	--	15.9	52.7	108.5	32.1	19.4	72.8	11.2	121.6
Aspen	2,338.9	238.6	4.7	23.9	438.3	518.5	125.8	103.2	233.3	72.2	580.4
Paper birch	317.3	34.8	--	2.1	35.0	95.9	17.9	10.8	19.8	17.1	83.9
Balsam poplar	226.5	15.8	--	1.0	77.2	26.5	15.9	5.9	38.7	10.7	34.8
Nonstocked	77.4	--	1.1	1.8	39.7	7.1	10.4	2.0	9.6	--	5.7
All types	5,975.5	567.2	12.6	70.5	1,370.5	1,204.6	380.6	285.0	596.7	155.3	1,332.5

Table 9.--Area of timberland by forest type and stand-size class, Northern Pine Unit, Minnesota, 1990

(In thousand acres)

Forest type	All stands	Stand-size class			
		Sawtimber	Poletimber	Sapling & seedling	Nonstocked
Jack pine	290.7	127.2	115.5	48.0	--
Red pine	167.0	94.1	39.7	33.2	--
White pine	24.3	18.4	5.9	--	--
Balsam fir	180.2	55.2	75.5	49.5	--
White spruce	27.4	7.7	10.3	9.4	--
Black spruce	348.2	19.9	105.7	222.6	--
Northern white-cedar	236.5	90.5	120.3	25.7	--
Tamarack	403.8	48.9	170.8	184.1	--
Oak-hickory	305.2	126.7	133.1	45.4	--
Elm-ash-soft maple	489.6	141.4	206.0	142.2	--
Maple-basswood	495.3	267.3	185.4	42.6	--
Aspen	2,379.2	802.4	810.5	766.3	--
Paper birch	321.2	86.4	195.9	38.9	--
Balsam poplar	229.5	56.0	81.6	91.9	--
Nonstocked	77.4	--	--	--	77.4
All types	5,975.5	1,942.1	2,256.2	1,699.8	77.4

Table 10.--Number of all live trees on timberland by species group and diameter class, Northern Pine Unit, Minnesota, 1990

(In thousand trees)

Species group	All classes	Diameter class (inches at breast height) 1.0-2.9	3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods													
Jack pine	103,506	21,530	21,872	23,927	19,025	10,731	4,207	1,557	480	136	23	18	--
Red pine	58,140	12,764	12,578	12,647	8,142	4,369	2,429	1,899	1,424	912	559	416	1
White pine	14,332	3,949	2,892	2,618	1,538	1,027	827	460	267	230	146	337	41
White spruce	23,677	7,860	5,890	4,172	2,600	1,471	858	327	266	105	87	41	--
Black spruce	277,938	145,140	84,719	36,370	9,163	1,956	504	55	19	--	6	6	--
Balsam fir	308,100	169,424	75,067	35,398	17,150	7,437	2,634	714	204	43	14	15	--
Tamarack	170,841	65,995	48,126	35,643	14,467	4,503	1,454	445	161	25	16	6	--
Eastern redcedar	102	--	--	--	102	--	--	--	--	--	--	--	--
Northern white-cedar	138,505	40,539	33,187	29,404	20,055	8,780	3,726	1,727	696	234	109	46	2
Other softwoods	301	90	168	22	17	--	4	--	--	--	--	--	--
Total	1,095,442	467,291	284,499	180,201	92,259	40,274	16,643	7,184	3,517	1,685	960	885	44
Hardwoods													
White oak	115,954	47,074	27,733	21,631	9,246	5,191	2,676	1,156	622	335	139	145	6
Select red oak	55,704	14,637	6,746	8,110	9,282	7,772	4,643	2,338	1,192	537	230	210	7
Other red oak	1,542	546	84	273	369	97	73	39	39	15	5	2	--
Hickory	367	174	--	152	10	27	--	4	--	--	--	--	--
Basswood	97,196	33,290	19,636	15,995	11,905	8,085	4,166	2,258	1,007	499	219	129	7
Yellow birch	6,084	3,510	1,220	439	355	193	132	123	43	27	23	19	--
Hard maple	136,405	76,665	26,846	17,607	7,025	3,311	2,168	1,213	891	385	183	107	4
Soft maple	110,016	45,221	30,873	21,040	7,408	3,153	1,131	513	282	154	104	113	24
Elm	64,334	29,403	16,118	8,499	4,421	2,967	1,459	630	422	180	107	122	6
Black ash	254,972	134,297	60,990	29,458	16,631	7,950	3,423	1,372	544	193	61	51	2
White and green ash	27,541	15,359	5,060	3,359	1,726	1,070	519	275	78	59	21	15	--
Cottonwood	11	--	--	--	10	--	--	--	--	--	--	1	--
Willow	247	150	36	37	11	--	5	5	3	--	--	--	--
Balsam poplar	130,256	64,687	23,792	16,362	11,836	7,343	3,454	1,661	649	330	88	52	2
Bigtooth aspen	43,673	23,247	5,077	3,396	3,367	3,362	2,655	1,454	715	253	104	42	1
Quaking aspen	938,748	599,275	126,881	67,918	50,967	41,060	27,705	14,568	6,522	2,497	828	520	7
Paper birch	201,694	55,379	48,170	41,622	31,371	15,791	6,124	2,276	660	209	52	38	2
Black cherry	9,395	7,653	882	553	262	45	--	--	--	--	--	--	--
Butternut	370	150	42		69	63	34	6	3	2	--	1	--
Other hardwoods	5,237	3,205	554	629	428	260	79	51	14	6	4	7	--
Noncommercial sp.	120,496	103,051	14,458	2,548	353	62	18	--	--	2	--	4	--
Total	2,320,242	1,256,973	415,198	259,628	167,052	107,802	60,464	29,942	13,686	5,683	2,168	1,578	68
All species	3,415,684	1,724,264	699,697	439,829	259,311	148,076	77,107	37,126	17,203	7,368	3,128	2,463	112

Table 11.--Number of growing-stock trees on timberland by species group and diameter class, Northern Pine Unit, Minnesota, 1990

(In thousand trees)

Species group	All classes	Diameter class (inches at breast height) 1.0-2.9	3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods													
Jack pine	97,140	20,064	19,852	22,411	18,403	10,289	4,037	1,504	427	117	19	17	--
Red pine	57,412	12,661	12,318	12,551	8,006	4,305	2,386	1,892	1,415	912	559	406	1
White pine	12,980	3,609	2,602	2,380	1,357	876	736	449	258	221	140	316	36
White spruce	23,428	7,860	5,824	4,069	2,581	1,464	825	312	266	99	87	41	--
Black spruce	269,087	142,067	80,946	34,621	8,981	1,882	504	55	19	--	6	6	--
Balsam fir	300,175	165,278	72,847	34,753	16,594	7,250	2,526	684	173	43	14	13	--
Tamarack	164,095	65,712	45,906	33,204	13,358	4,037	1,271	417	147	22	15	6	--
Eastern redcedar	73	--	--	--	73	--	--	--	--	--	--	--	--
Northern white-cedar	116,741	39,069	28,412	23,377	15,139	6,272	2,540	1,184	481	166	74	27	--
Other softwoods	301	90	168	22	17	--	4	--	--	--	--	--	--
Total	1,041,432	456,410	268,875	167,388	84,509	36,375	14,829	6,497	3,186	1,580	914	832	37
Hardwoods													
White oak	109,104	45,190	25,825	20,172	8,618	4,844	2,371	1,025	534	295	121	104	5
Select red oak	50,839	14,589	6,236	6,635	8,397	7,046	4,189	2,029	959	440	168	147	4
Other red oak	1,380	546	24	249	343	91	54	22	30	15	4	2	--
Hickory	342	174	--	127	10	27	--	4	--	--	--	--	--
Basswood	91,136	32,744	17,664	14,442	11,218	7,595	3,812	2,064	903	438	163	90	3
Yellow birch	4,972	3,270	982	302	145	99	65	50	23	18	16	2	--
Hard maple	120,494	71,033	23,310	14,971	5,657	2,365	1,483	706	580	233	104	50	2
Soft maple	93,078	42,277	24,782	16,862	5,565	2,208	753	289	137	61	62	67	15
Elm	58,958	27,872	14,448	7,842	3,778	2,615	1,222	487	355	155	87	91	6
Black ash	240,501	130,127	55,350	27,154	15,448	7,331	3,112	1,212	507	173	48	39	--
White and green ash	26,393	15,299	4,678	2,977	1,619	945	479	231	75	57	21	12	--
Cottonwood	11	--	--	--	10	--	--	--	--	--	--	1	--
Willow	228	150	36	37	--	--	--	5	--	--	--	--	--
Balsam poplar	125,673	64,314	22,664	15,261	10,885	6,752	3,241	1,541	605	298	71	40	1
Bigtooth aspen	41,235	23,247	4,647	3,117	3,018	2,843	2,318	1,208	565	194	56	21	1
Quaking aspen	902,973	596,942	121,788	61,364	44,864	35,611	23,225	11,856	4,948	1,634	493	246	2
Paper birch	182,404	52,423	42,331	36,792	28,243	14,443	5,445	1,969	520	176	33	28	1
Black cherry	8,222	7,180	696	220	98	28	--	--	--	--	--	--	--
Butternut	328	150	42	--	40	63	21	6	3	2	--	1	--
Other hardwoods	4,608	3,075	411	552	327	190	27	23	1	--	2	--	--
Total	2,062,879	1,130,602	365,914	229,076	148,283	95,096	51,817	24,727	10,745	4,189	1,449	941	40
All species	3,104,311	1,587,012	634,789	396,464	232,792	131,471	66,646	31,224	13,931	5,769	2,363	1,773	77

Table 12.--Net volume of timber on timberland by class of timber and species group, Northern Pine Unit, Minnesota, 1990

(In thousand cubic feet)

Class of timber	All species	Species group			
		Pine	Other softwoods	Soft hardwoods	Hard hardwoods
Live trees					
Growing-stock trees					
Sawtimber					
Saw-log portion	2,455,132	526,375	389,958	1,191,898	346,901
Upper stem portion	731,948	68,039	60,769	464,657	138,483
Total	3,187,080	594,414	450,727	1,656,555	485,384
Poletimber	3,399,269	240,887	658,353	1,870,567	629,462
All growing-stock trees	6,586,349	835,301	1,109,080	3,527,122	1,114,846
Cull trees					
Short-log trees	87,998	3,691	9,366	52,733	22,208
Rough trees					
Sawtimber	161,973	9,105	21,494	88,740	42,634
Poletimber	255,431	7,265	38,505	148,712	60,949
Total	417,404	16,370	59,999	237,452	103,583
Rotten trees					
Sawtimber	132,996	1,899	17,337	94,031	19,729
Poletimber	41,105	262	7,219	27,896	5,728
Total	174,101	2,161	24,556	121,927	25,457
All cull trees	679,503	22,222	93,921	412,112	151,248
All live trees	7,265,852	857,523	1,203,001	3,939,234	1,266,094
Salvable dead trees					
Sawtimber	46,407	5,677	12,263	27,615	852
Poltetimber	34,102	2,641	8,275	20,686	2,500
Total	80,509	8,318	20,538	48,301	3,352
All classes of timber	7,346,361	865,841	1,223,539	3,987,535	1,269,446

Table 13.--Net volume of growing-stock trees on timberland by species group and diameter class, Northern Pine Unit, Minnesota, 1990

(In thousand cubic feet)

Species group	All classes	Diameter class (inches at breast height) 5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods											
Jack pine	369,013	53,095	98,657	98,721	62,402	34,961	13,833	5,018	1,087	1,239	--
Red pine	355,600	32,557	44,033	43,489	38,710	45,310	47,662	39,949	31,826	31,961	103
White pine	110,473	5,314	7,096	8,333	11,718	10,881	8,636	10,073	8,638	32,899	6,885
White spruce	85,755	10,787	15,190	15,478	13,821	7,726	9,509	4,646	5,177	3,421	--
Black spruce	174,799	91,794	51,668	19,868	8,416	1,399	670	--	343	641	--
Balsam fir	326,440	87,736	96,336	75,513	41,108	16,411	5,723	1,927	864	822	--
Tamarack	257,928	93,921	83,005	43,277	20,856	9,886	4,755	964	830	434	--
Eastern redcedar	421	--	421	--	--	--	--	--	--	--	--
Northern white-cedar	263,737	52,923	74,572	54,388	34,555	23,709	12,893	5,789	3,342	1,566	--
Other softwoods	215	64	71	--	80	--	--	--	--	--	--
Total	1,944,381	428,191	471,049	359,067	231,666	150,283	103,681	68,366	52,107	72,983	6,988
Hardwoods											
White oak	223,700	42,498	43,972	43,182	33,557	21,189	15,075	11,123	5,575	6,876	653
Select red oak	302,179	16,062	44,454	67,096	63,258	44,794	28,905	17,935	8,586	10,632	457
Other red oak	5,716	694	1,494	795	755	434	778	507	166	93	--
Hickory	620	207	70	258	--	85	--	--	--	--	--
Basswood	360,881	39,261	67,533	81,386	61,263	48,924	29,105	17,914	8,133	7,070	292
Yellow birch	7,125	799	849	967	1,058	1,172	721	683	753	123	--
Hard maple	183,183	39,890	34,636	25,930	25,218	17,333	19,359	10,409	6,172	4,028	208
Soft maple	135,302	42,920	32,541	23,119	12,500	6,993	4,406	2,636	3,148	5,171	1,868
Elm	121,041	17,135	20,754	25,208	18,347	10,833	10,788	6,246	4,202	6,792	736
Black ash	342,998	70,033	90,283	75,792	50,284	28,338	15,943	7,148	2,476	2,701	--
White and green ash	44,421	6,876	9,092	9,458	7,247	5,366	2,355	2,162	1,020	845	--
Cottonwood	156	--	65	--	--	--	--	--	--	--	--
Willow	173	87	--	--	--	86	--	--	--	--	--
Balsam poplar	303,463	40,227	62,718	70,873	52,809	36,122	20,209	12,805	3,928	3,609	163
Bigtooth aspen	167,202	8,996	19,367	32,854	41,128	30,992	20,022	8,993	3,200	1,528	122
Quaking aspen	1,814,162	164,550	275,950	392,776	397,435	293,561	167,762	74,493	28,294	18,993	348
Paper birch	621,468	110,921	179,249	159,580	94,422	48,262	17,445	7,549	1,863	2,067	110
Black cherry	1,553	580	654	319	--	--	--	--	--	--	--
Butternut	1,721	--	275	669	347	140	98	95	--	97	--
Other hardwoods	4,904	1,023	1,536	1,516	309	387	20	--	91	22	--
Total	4,641,968	602,759	885,492	1,011,778	859,937	595,011	352,991	180,698	77,607	70,738	4,957
All species	6,586,349	1,030,950	1,356,541	1,370,845	1,091,603	745,294	456,672	249,064	129,714	143,721	11,945

Table 14.--Net volume of growing stock in the saw-log portion of sawtimber trees on timberland by species group and diameter class, Northern Pine Unit, Minnesota, 1990

(In thousand cubic feet)

Species group	All classes	Diameter class (inches at breast height) 9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods									
Jack pine	184,945	80,332	54,439	31,140	12,409	4,522	980	1,123	--
Red pine	256,874	38,346	35,741	42,206	44,360	37,095	29,497	29,534	95
White pine	84,485	6,445	9,847	9,366	7,507	8,787	7,546	28,880	6,107
White spruce	53,884	13,239	12,515	7,109	8,780	4,291	4,783	3,167	--
Black spruce	28,935	18,066	7,977	1,331	637	--	324	600	--
Balsam fir	119,892	61,312	35,671	14,555	5,110	1,725	778	741	--
Tamarack	71,115	36,817	18,815	9,056	4,372	888	765	402	--
Eastern redcedar	--	--	--	--	--	--	--	--	--
Northern white-cedar	116,132	44,004	29,981	21,016	11,525	5,196	3,000	1,410	--
Other softwoods	71	--	71	--	--	--	--	--	--
Total	916,333	298,561	205,057	135,779	94,700	62,504	47,673	65,857	6,202
Hardwoods									
White oak	66,329	--	21,511	15,081	11,196	8,418	4,284	5,323	516
Select red oak	123,262	--	40,699	32,114	21,555	13,646	6,608	8,280	360
Other red oak	1,980	--	494	313	585	387	128	73	--
Hickory	58	--	--	58	--	--	--	--	--
Basswood	125,659	--	40,979	36,208	22,296	13,939	6,399	5,602	236
Yellow birch	3,434	--	733	885	565	547	604	100	--
Hard maple	59,414	--	16,340	12,462	14,540	7,965	4,771	3,167	169
Soft maple	26,084	--	7,907	4,973	3,275	2,004	2,415	4,026	1,484
Elm	39,824	--	11,154	7,455	7,763	4,588	3,142	5,152	570
Black ash	78,069	--	34,511	21,347	12,419	5,664	1,966	2,162	--
White and green ash	13,765	--	4,863	3,975	1,798	1,673	798	658	--
Cottonwood	71	--	--	--	--	--	--	71	--
Willow	54	--	--	54	--	--	--	--	--
Balsam poplar	93,113	--	35,436	26,536	15,325	9,849	3,033	2,807	127
Bigtooth aspen	78,002	--	28,362	23,257	15,496	7,050	2,525	1,214	98
Quaking aspen	711,843	--	270,347	217,919	128,468	57,799	22,110	14,926	274
Paper birch	116,681	--	60,877	34,237	12,858	5,656	1,404	1,564	85
Butternut	567	--	235	103	77	74	--	78	--
Other hardwoods	590	--	200	285	16	--	71	18	--
Total	1,538,799	--	574,648	437,262	268,232	139,259	60,258	55,221	3,919
All species	2,455,132	298,561	779,705	573,041	362,932	201,763	107,931	121,078	10,121

Table 15.--Net volume of sawtimber trees on timberland by species group and diameter class, Northern Pine Unit, Minnesota, 1990

(In thousand board feet)[1]

Species group	All classes	Diameter class (inches at breast height) 9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods									
Jack pine	1,071,245	469,913	307,190	179,410	73,662	27,636	6,180	7,254	--
Red pine	1,512,136	220,122	199,098	240,006	259,730	223,238	181,748	187,566	628
White pine	522,056	38,350	55,483	53,607	44,229	53,320	46,995	188,521	41,551
White spruce	323,071	78,932	72,148	41,741	52,975	26,521	30,196	20,558	--
Black spruce	166,569	103,859	45,150	7,746	3,825	--	2,034	3,955	--
Balsam fir	697,608	360,359	202,682	84,141	30,323	10,564	4,856	4,683	--
Tamarack	418,593	217,754	108,584	53,115	26,267	5,470	4,801	2,602	--
Eastern redcedar	--	--	--	--	--	--	--	--	--
Northern white-cedar	699,042	272,460	175,353	123,200	68,789	31,609	18,644	8,987	--
Other softwoods	399	--	399	--	--	--	--	--	--
Total	5,410,719	1,761,749	1,166,087	782,966	559,800	378,358	295,454	424,126	42,179
Hardwoods									
White oak	414,766	--	136,597	92,325	68,669	52,289	27,038	34,375	3,473
Select red oak	767,799	--	256,773	196,055	132,209	84,907	41,746	53,668	2,441
Other red oak	12,308	--	3,144	1,915	3,586	2,394	804	465	--
Hickory	358	--		358	--	--	--	--	--
Basswood	785,822	--	259,822	222,731	137,681	87,191	40,491	36,332	1,574
Yellow birch	21,689	--	4,704	5,514	3,528	3,435	3,858	650	--
Hard maple	375,526	--	104,881	77,530	90,625	50,229	30,509	20,622	1,130
Soft maple	166,842	--	50,995	31,024	20,425	12,639	15,420	26,262	10,077
Elm	252,872	--	72,399	46,308	48,188	28,742	19,918	33,469	3,848
Black ash	489,672	--	218,970	131,770	76,925	35,518	12,485	14,004	--
White and green ash	85,136	--	30,338	24,135	11,022	10,368	5,032	4,241	--
Cottonwood	465	--	--	--	--	--	--	465	--
Willow	336	--	--	336	--	--	--	--	--
Balsam poplar	580,470	--	222,770	162,895	94,698	61,644	19,304	18,296	863
Bigtooth aspen	483,468	--	176,529	142,316	95,780	44,231	16,073	7,873	666
Quaking aspen	4,419,127	--	1,688,916	1,334,644	793,336	362,535	140,889	96,946	1,861
Paper birch	734,173	--	386,565	212,270	79,982	35,627	8,978	10,181	570
Butternut	3,598	--	1,507	642	478	466	--	505	--
Other hardwoods	3,697	--	1,300	1,742	97	--	445	113	--
Total	9,598,124	--	3,616,210	2,684,510	1,657,229	872,215	382,990	358,467	26,503
All species	15,008,843	1,761,749	4,782,297	3,467,476	2,217,029	1,250,573	678,444	782,593	68,682

[1]International 1/4-inch rule.

Table 16.--Net volume of growing-stock and sawtimber trees on timberland by county and species group, Northern Pine Unit, Minnesota, 1990

County	Growing stock					Sawtimber				
		Species group					Species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	Thousand cubic feet					*Thousand board feet*[1]				
Aitkin	765,414	21,964	133,468	397,526	212,456	1,690,282	74,346	256,121	910,920	448,895
Becker	421,020	36,279	31,461	243,590	109,690	987,722	140,886	71,883	517,115	257,838
Beltrami	914,207	90,406	204,533	517,843	101,425	2,013,226	369,453	400,965	1,080,758	162,050
Cass	1,062,075	177,804	118,681	577,330	188,260	2,584,572	694,805	269,733	1,265,669	354,365
Clearwater	348,653	30,131	36,311	231,750	50,461	765,441	118,307	102,336	441,665	103,133
Crow Wing	475,196	72,762	23,463	232,577	146,394	1,077,799	241,420	49,371	471,516	315,492
Hubbard	454,118	115,373	33,029	237,292	68,424	962,760	348,616	100,793	394,833	118,518
Itasca	1,446,614	198,079	353,785	740,915	153,835	3,590,987	838,930	765,740	1,724,849	261,468
Lake of the Woods	306,546	29,676	127,809	137,739	11,322	551,579	97,353	193,735	242,987	17,504
Mahnomen	137,400	1,692	1,202	94,755	39,751	257,817	7,477	3,112	185,318	61,910
Roseau	160,584	22,160	42,280	84,952	11,192	327,559	80,736	87,537	144,753	14,533
Wadena	94,522	38,975	3,058	30,853	21,636	199,099	93,507	3,557	46,790	55,245
All counties	6,586,349	835,301	1,109,080	3,527,122	1,114,846	15,008,843	3,105,836	2,304,883	7,427,173	2,170,951

[1]International 1/4-inch rule.

Table 17.--Net volume of live and growing-stock trees on timberland by ownership class and species group, Northern Pine Unit, Minnesota, 1990

(In thousand cubic feet)

Ownership class	Live trees					Growing stock				
		Species group					Species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
National forest	798,713	169,183	130,454	410,551	88,525	743,197	168,461	121,409	378,421	74,906
Bureau of Land Mgmt.	16,743	5,933	3,458	6,033	1,319	15,525	5,765	3,291	5,150	1,319
Miscellaneous federal	102,926	8,643	11,090	61,314	21,879	88,786	8,284	10,463	52,160	17,879
State	1,352,500	129,708	423,867	645,914	153,011	1,229,323	126,235	387,964	580,054	135,070
County and municipal	1,562,720	155,048	215,578	920,684	271,410	1,421,756	150,963	199,108	826,852	244,833
Indian	453,064	42,767	111,000	243,154	56,143	413,609	41,824	101,978	219,874	49,933
Forest industry	281,073	63,512	48,405	135,905	33,251	248,080	61,671	44,704	115,172	26,533
Farmer	761,151	70,908	66,785	424,264	199,194	688,112	67,568	62,464	378,967	179,113
Miscellaneous private corporation	201,458	14,877	21,464	128,499	36,618	178,493	14,440	20,359	112,224	31,470
Miscellaneous private individual	1,735,504	196,944	170,900	962,916	404,744	1,559,468	190,090	157,340	858,248	353,790
All owners	7,265,852	857,523	1,203,001	3,939,234	1,266,094	6,586,349	835,301	1,109,080	3,527,122	1,114,846

Table 18.--Net volume of sawtimber trees on timberland by species group and butt log grade, Northern Pine Unit, Minnesota, 1990

(In thousand board feet)[1]

Species group	All grades	Butt log grade			
		1	2	3	Tie and timber
Softwoods					
Jack pine	1,071,245	1,548	68,523	1,001,174	--
Red pine	1,512,136	169,224	329,370	1,012,541	1,001
White pine	522,056	83,468	143,109	199,850	95,629
White spruce	323,071	5,323	36,099	279,368	2,281
Black spruce	166,569	--	6,309	160,260	--
Balsam fir	697,608	--	15,277	682,331	--
Tamarack	418,593	--	18,993	399,600	--
Eastern redcedar	--	--	--	662,452	6,967
Northern white-cedar	699,042	1,676	27,947	--	--
Other softwoods	399	--	--	399	--
Total	5,410,719	261,239	645,627	4,397,975	105,878
Hardwoods					
White oak	414,766	20,588	83,470	266,864	43,844
Select red oak	767,799	33,095	157,600	524,831	52,273
Other red oak	12,308	--	--	10,319	1,989
Hickory	358	--	--	358	--
Basswood	785,822	150,034	262,270	362,656	10,862
Yellow birch	21,689	2,333	4,743	12,696	1,917
Hard maple	375,526	64,968	148,359	153,685	8,514
Soft maple	166,842	33,803	41,253	90,683	1,103
Elm	252,872	14,131	81,771	156,970	--
Black ash	489,672	52,828	153,181	273,949	9,714
White and green ash	85,136	6,872	23,634	53,177	1,453
Cottonwood	465	--	--	465	--
Willow	336	--	--	336	--
Balsam poplar	580,470	19,495	89,902	440,330	30,743
Bigtooth aspen	483,468	22,711	107,310	339,321	14,126
Quaking aspen	4,419,127	134,588	716,608	3,301,590	266,341
Paper birch	734,173	34,421	147,282	516,729	35,741
Butternut	3,598	2,494	--	1,104	--
Other hardwoods	3,697	--	--	3,697	--
Total	9,598,124	592,361	2,017,383	6,509,760	478,620
All species	15,008,843	853,600	2,663,010	10,907,735	584,498

[1]International 1/4-inch rule.

Table 19.--Average net annual growth of growing stock and sawtimber on timberland by county and species group, Northern Pine Unit, Minnesota, 1977-1989

County	Growing stock					Sawtimber				
		Species group					Species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	Thousand cubic feet					*Thousand board feet*[1]				
Aitkin	21,521	1,140	3,712	10,672	5,997	66,260	4,234	10,516	35,176	16,334
Becker	8,090	701	498	3,907	2,984	33,289	3,999	1,615	18,195	9,480
Beltrami	22,004	2,717	3,612	12,725	2,950	77,503	13,321	14,450	43,548	6,184
Cass	26,206	5,521	1,668	13,658	5,359	103,434	23,929	10,276	54,328	14,901
Clearwater	9,393	914	882	6,022	1,575	32,281	3,989	3,596	20,866	3,830
Crow Wing	14,094	2,198	577	7,035	4,284	52,772	10,038	1,893	26,422	14,419
Hubbard	13,947	4,189	458	7,197	2,103	45,014	16,317	2,225	22,179	4,293
Itasca	33,565	5,963	7,416	16,295	3,891	136,264	26,785	28,517	72,139	8,823
Lake of the Woods	8,729	647	3,481	4,165	436	23,461	3,036	8,562	11,217	646
Mahnomen	2,937	78	35	1,757	1,067	10,115	689	65	6,715	2,646
Roseau	5,172	660	1,043	3,083	386	11,760	2,207	3,088	5,949	516
Wadena	4,121	2,232	130	1,131	628	10,984	5,230	284	2,830	2,640
All counties	169,779	26,960	23,512	87,647	31,660	603,137	113,774	85,087	319,564	84,712

[1]International 1/4-inch rule.

Table 20.--Average annual removals of growing stock and sawtimber on timberland by county and species group, Northern Pine Unit, Minnesota, 1977-1989

County	Growing stock					Sawtimber				
		Species group					Species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	Thousand cubic feet					*Thousand board feet*[1]				
Aitkin	6,644	99	675	4,893	977	18,772	417	1,674	13,782	2,899
Becker	3,001	651	149	1,683	518	7,896	2,765	504	3,313	1,314
Beltrami	13,541	3,202	1,869	8,073	397	35,872	12,580	3,951	18,834	507
Cass	14,606	2,059	1,245	10,072	1,230	32,023	7,348	3,696	18,643	2,336
Clearwater	3,433	378	298	2,674	83	7,350	1,851	956	4,283	260
Crow Wing	6,405	992	9	3,651	1,753	15,161	3,338	45	8,828	2,950
Hubbard	6,710	1,489	79	4,853	289	13,797	6,327	321	6,672	477
Itasca	28,327	1,358	4,884	20,503	1,582	68,157	6,308	13,270	46,735	1,844
Lake of the Woods	1,882	515	78	1,289	--	4,931	1,298	227	3,406	--
Mahnomen	1,117	98	24	673	322	2,576	386	134	1,233	823
Roseau	842	412	77	213	140	2,313	1,880	296	137	--
Wadena	1,379	507	53	704	115	3,556	1,743	251	1,425	137
All counties	87,887	11,760	9,440	59,281	7,406	212,404	46,241	25,325	127,291	13,547

[1]International 1/4-inch rule.

Table 21.--Average net annual growth, mortality, and removals of growing stock and sawtimber on timberland by species group, Northern Pine Unit, Minnesota, 1977-1989

Species group	Growing stock			Sawtimber		
	Net growth[1]	Mortality	Removals	Net growth[1]	Mortality	Removals
	Thousand cubic feed			*Thousand board feet*[2]		
Softwoods						
Jack pine	8,775	6,240	8,156	37,701	18,265	28,828
Red pine	14,263	330	2,009	56,253	1,816	9,569
White pine	3,908	364	1,595	19,805	2,002	7,844
White spruce	3,312	729	1,154	13,790	3,120	5,698
Black spruce	2,456	3,734	521	4,686	3,873	460
Balsam fir	6,469	10,344	5,837	24,749	23,067	14,742
Tamarack	6,029	3,015	1,244	20,103	4,562	2,835
Eastern redcedar	14	--	--	--	--	--
Northern white-cedar	5,209	573	684	21,606	1,938	1,590
Other softwoods	37	--	--	168	--	--
Total	50,472	25,329	21,200	198,861	58,643	71,566
Hardwoods						
White oak	7,122	406	1,427	16,901	1,209	2,411
Select red oak	7,564	1,979	2,979	32,920	3,421	6,301
Other red oak	-15	152	73	364	64	127
Hickory	15	14	--	6	51	--
Basswood	9,749	1,383	1,699	28,145	3,106	2,414
Yellow birch	-21	92	22	180	171	--
Hard maple	5,689	537	924	11,083	1,327	1,574
Soft maple	5,984	947	679	6,798	1,202	612
Elm	-2,977	8,988	1,288	-7,939	22,715	3,887
Black ash	9,414	1,858	1,934	18,587	3,416	3,134
White and green ash	1,775	137	47	4,365	154	--
Cottonwood	-4	8	--	5	1	--
Willow	30	14	--	29	5	--
Balsam poplar	4,610	8,080	3,400	13,476	16,953	7,136
Bigtooth aspen	4,844	1,413	1,779	23,788	3,424	4,263
Quaking aspen	54,593	33,602	43,019	225,729	70,193	101,525
Paper birch	10,794	8,705	7,389	29,383	8,840	7,337
Black cherry	18	45	--	--	--	--
Butternut	6	25	28	150	--	117
Other hardwoods	120	86	--	306	93	--
Total	119,310	68,471	66,687	404,276	136,345	140,838
All species	169,779	93,800	87,887	603,137	194,988	212,404

[1]An estimate of average gross growth may be computed by adding average mortality to average net growth.

[2]International 1/4-inch rule.

Table 22.--Average net annual growth and average annual removals of growing stock on timberland by ownership class and species group, Northern Pine Unit, Minnesota, 1977-1989

(In thousand cubic feet)

Ownership class	Growth					Removals				
		Species group					Species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
National forest	19,055	5,162	2,431	9,240	2,222	16,052	360	3,042	11,670	980
Bureau of Land Mgmt.	268	86	78	67	37	163	155	--	8	--
Miscellaneous federal	1,691	203	271	871	346	597	--	41	556	--
State	29,886	4,264	7,112	14,798	3,712	12,302	2,739	1,530	7,223	810
County and municipal	35,051	4,561	3,558	19,840	7,092	20,223	2,742	1,777	14,423	1,281
Indian	9,625	1,167	2,300	4,682	1,476	2,648	1,358	557	688	45
Forest industry	8,138	3,116	1,227	3,134	661	6,543	552	338	4,869	784
Farmer	19,134	2,184	1,802	10,081	5,067	8,675	690	869	6,079	1,037
Miscellaneous private corporation	4,317	532	399	2,532	854	2,777	639	242	1,824	72
Miscellaneous private individual	42,614	5,685	4,334	22,402	10,193	17,907	2,525	1,044	11,941	2,397
All owners	169,779	26,960	23,512	87,647	31,660	87,887	11,760	9,440	59,281	7,406

Table 23.--Average net annual growth and average annual removals of sawtimber on timberland by ownership class and species group, Northern Pine Unit, Minnesota, 1977-1989

(In thousand board feet)[1]

Ownership class	Growth					Removals				
		Species group					Species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
National forest	81,198	24,919	13,683	37,088	5,508	34,513	912	9,343	23,427	831
Bureau of Land Mgmt.	1,866	877	251	639	99	546	546	--	--	--
Miscellaneous federal	8,540	1,112	1,101	4,808	1,519	1,848	--	239	1,609	
State	96,365	16,449	20,273	50,705	8,938	32,024	10,734	3,746	16,329	1,215
County and municipal	129,382	20,161	14,455	75,942	18,824	49,436	11,442	4,724	30,605	2,665
Indian	34,419	5,442	7,719	18,467	2,791	8,140	6,171	770	1,063	136
Forest industry	26,304	8,473	3,983	12,481	1,367	14,034	1,379	934	10,335	1,386
Farmer	62,118	9,038	6,532	31,220	15,328	20,454	2,805	2,366	12,985	2,298
Miscellaneous private corporation	16,693	2,604	1,699	9,955	2,435	7,197	2,407	527	4,263	--
Miscellaneous private individual	146,252	24,699	15,391	78,259	27,903	44,212	9,845	2,676	26,675	5,016
All owners	603,137	113,774	85,087	319,564	84,712	212,404	46,241	25,325	127,291	13,547

[1]International 1/4-inch rule.

Table 24.--Current annual growth, mortality, and removals of growing stock and sawtimber on timberland by species group, Northern Pine Unit, Minnesota, 1989

Species group	Growing stock			Sawtimber		
	1989 Net growth[1]	1989 Mortality	1988 Removals[2]	1989 Net growth[1]	1989 Mortality	1988 Removals[2]
	Thousand cubic feet			*Thousand board feet*[3]		
Softwoods						
Jack pine	8,667	6,668	8,911	42,367	20,115	33,139
Red pine	17,266	74	6,346	65,821	938	31,079
White pine	5,610	87	1,641	28,140	1,052	9,075
Spruce	8,287	3,967	2,660	26,284	5,347	6,639
Balsam fir	9,446	8,617	5,897	42,571	17,448	14,957
Tamarack	7,016	2,732	311	27,233	3,538	548
Cedar	5,951	315	1,594	22,422	2,065	1,493
Other softwoods	28	2	--	1	15	--
Total	62,271	26,813	27,360	254,839	95,533	96,930
Hardwoods						
White oak	8,857	8	819	21,516	211	1,872
Red oak	9,328	2,098	2,834	40,889	4,322	8,937
Basswood	11,655	1,591	1,128	32,520	4,313	5,272
Yellow birch	88	120	44	36	363	208
Hard maple	7,187	589	437	12,630	1,773	989
Soft maple	7,815	1,797	506	10,145	1,507	1,017
Elm	2,067	3,952	847	4,825	9,483	2,927
Ash	13,606	2,295	1,355	30,352	4,003	5,372
Cottonwood	3	1	228	5	1	141
Balsam poplar	8,204	7,028	1,502	25,612	14,772	3,107
Aspen	66,469	38,853	76,412	288,131	92,286	216,946
Paper birch	14,394	8,621	3,962	40,095	9,441	12,733
Other hardwoods	342	228	51	833	155	183
Total	150,015	67,181	90,125	507,589	142,630	259,704
All species	212,286	93,994	117,485	762,428	238,163	356,634

[1]An estimate of current gross growth may be computed by adding current mortality to current net growth.

[2]Based on data from a 1988 mill survey and a1989-1990 logging utilization study, and on land use change estimates from the new inventory.

[3]International 1/4-inch rule.

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The fifth inventory of Minnesota's Northern Pine Unit reports 11.1 million acres of land, of which 6.3 million acres are forested. This bulletin presents statistical highlights and contains detailed tables of forest area, as well as timber volume, growth, removals, mortality, and ownership.

KEY WORDS: Forest area, timber volume, growth, removals, mortality.

Our job at the North Central Forest Experiment Station is discovering and creating new knowledge and technology in the field of natural resources and conveying this information to the people who can use it. As a new generation of forests emerges in our region, managers are confronted with two unique challenges: (1) Dealing with the great diversity in composition, quality, and ownership of the forests, and (2) Reconciling the conflicting demands of the people who use them. Helping the forest manager meet these challenges while protecting the environment is what research at North Central is all about.